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1914/15

THE UNIVERSITY BULLETINS

FIFTEENTH SERIES: NO. 4—PART 12

University of Pennsylvania

Founded 1740



Announcement of the Towne Scientific School

Founded 1875

1914-1915

PHILADELPHIA:
Published by the University
April, 1915
BI-MONTHLY

SPECIAL NOTICE.

Copies of the University Catalogue (containing detailed information concerning all the Schools) may be obtained ONLY upon application to the Secretary of the University, Law School Building.

To any alumnus of the University, the Catalogue will be sent upon application on receipt of name, class and address.

The special announcement of the following divisions of the University will be sent upon application to the appropriate Dean:

THE COLLEGE.

THE TOWNE SCIENTIFIC SCHOOL, including

THE COURSES IN ARCHITECTURE.

THE COURSE IN CHEMICAL ENGINEERING.

THE COURSE IN CHEMISTRY.

THE COURSE IN CIVIL ENGINEERING.

THE COURSE IN ELECTRICAL ENGINEERING.

THE COURSE IN MECHANICAL ENGINEERING.

THE WHARTON SCHOOL OF FINANCE AND COMMERCE.

THE SCHOOL OF EDUCATION.

THE GRADUATE SCHOOL.

THE LAW SCHOOL.

THE SCHOOL OF MEDICINE.

THE SCHOOL OF DENTISTRY.

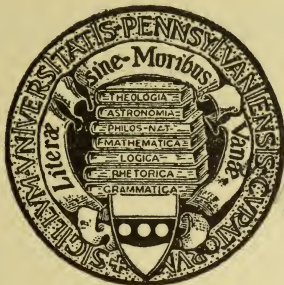
THE SCHOOL OF VETERINARY MEDICINE.

Bi-Monthly

Entered at the Philadelphia, Pa., Post-Office as Second-Class Matter.

University of Pennsylvania

Founded 1740



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UNIVERSITY OF PENNSYLVANIA
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April, 1915

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THE UNIVERSITY.

General Information.

LOCATION.

The buildings of the University of Pennsylvania, thirty-one in number, are situated in Philadelphia, on property covering an area of over fifty-nine acres. In addition to this land the University has recently acquired from the city an adjoining tract comprising fifty-five acres, more or less. The University may be reached from the various railroad stations as follows: From the West Philadelphia station of the Pennsylvania Railroad, on foot west on Woodland Avenue, a walk of less than ten minutes; from the Philadelphia and Reading Terminal station by the subway, Thirteenth and Market Streets, west to Thirty-fourth Street, by Darby, Angora or Chester cars; or from the Baltimore and Ohio Railroad station by a walk of one square south to Walnut Street, thence by car over the bridge west to Thirty-fourth Street.

APPLICATIONS FOR CATALOGUES, ETC.

Applications for copies of the annual University Catalogue should be addressed to the Secretary of the University of Pennsylvania, Philadelphia, Pa.

The University also issues pamphlets relating to the Towne Scientific School and the several Schools or to individual Departments and often containing information not found in the Catalogue. Inquirers interested in special branches of work only are advised to apply for these pamphlets, not for the Catalogue.

All letters of inquiry regarding the internal regulations and requirements of the Towne Scientific School should be addressed to the Dean, and *not* to the Secretary of the University.

ACCOMMODATIONS FOR STUDENTS.

Lodging for students to the number of nearly nine hundred is provided in the present dormitory system, which comprises an extended group of contiguous houses fronting upon three open courts. Plans of the dormitories, prices, and other details may be obtained upon application to the Bursar of the University, College Hall.

Board and lodging may be obtained also in the immediate vicinity of the University. Upon application at the office of the Dean, lists of approved boarding houses may be seen.

HOUSTON HALL.

Houston Hall is the home of the Houston Club, to membership in which any member of the University is eligible. A fee of ten dollars (\$10.00) is added to the tuition fee of every student in the Towne Scientific School for the privileges of the Gymnasium and the Houston Club.

The Club is the exponent of the social side of Pennsylvania life. Its purposes are to provide for the students a place where all may meet socially on common ground, and to furnish every available facility for healthy recreation and amusement in leisure hours. The equipment of the Hall includes a library and reading room, with a large number of periodicals and newspapers; smoking rooms, billiard and pool tables, tables for chess and checkers, a correspondence room, bowling alleys, shuffle boards; athletic trophy rooms; a large auditorium with grand organ; rooms for the University papers and other organizations; a post-office "sub-station," barber shop, book and general supply store; a luncheon buffet and dining room; a dark room for amateur photographers and many other rooms for general purposes.

The Christian Association, which has its headquarters in Houston Hall, is prepared to furnish prospective students, through its Secretary, full information with regard to the various undergraduate social activities, both secular and religious.

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CALENDAR FOR 1914-15, 1915-16.

Meetings of the Corporation are held on the second Monday in each month.

1915

- Jan. 4, MondayChristmas Recess ends: 9 A. M.
Jan. 18, MondayEntrance Examinations: 4.30 P. M.
Jan. 25, MondayMid-Year Examinations: 9 A. M.
Feb. 1, MondayRe-examination of Students conditioned in
Second Term Courses, 9 A. M.
Feb. 8, MondaySecond Term begins:
Feb. 22, MondayUniversity Day. Recess in all Departments.
Mar. 31, Wednesday ...Easter Recess begins: 6 P. M.
April 8, ThursdayEaster Recess ends: 9 A. M.
May 3, MondayLast day for receipt of Theses, Prize
Essays and Reports.
May 31, MondayFinal Examinations: 9 A. M.
June 13, SundayGraduation Sermon.
June 16, Wednesday ...Commencement, 11 A. M.
June 17, ThursdayRegistration of Candidates for Admission
by Examination: 9 A. M.
June 17, ThursdayEntrance Examinations: 9 A. M.
June 17, ThursdayRe-examination of Conditioned Students:
9 A. M.
July 6, TuesdaySummer School Session begins: 9 A. M.
Aug. 14, SaturdaySummer School Session ends: 6 P. M.

SUMMER RECESS.

- Sept. 13, MondayRegistration of Candidates for Admission
by Examination: 9 A. M. to 11 A. M.
Sept. 13, MondayEntrance Examinations: 9 A. M.
Sept. 14, TuesdayRe-examination of Conditioned Students:
9 A. M.
Sept. 21, 22, 23Registration and Advising of Students:
Sept. 24, FridaySession begins:
Nov. 24, Wednesday ...Thanksgiving Recess begins: 6 P. M.
Nov. 29, MondayThanksgiving Recess ends: 9 A. M.
Dec. 23, ThursdayChristmas Recess begins: 6 P. M.

1916

- Jan. 3, MondayChristmas Recess ends: 9 A. M.
Jan. 17, MondayEntrance Examinations: 4.30 P. M.
Jan. 24, MondayMid-Year Examinations: 9 A. M.
Jan. 31, MondayRe-examination of Students conditioned in
Second Term Courses.
Feb. 7, MondaySecond Term begins:
Feb. 22, TuesdayUniversity Day. Recess in all Departments.
April 19, Wednesday ..Easter Recess begins: 6 P. M.
April 27, ThursdayEaster Recess ends: 9 A. M.
May 1, MondayLast day for receipt of Theses, Prize
Essays and Reports.
June 5, MondayFinal Examinations: 9 A. M.
June 18, SundayGraduation Sermon.
June 21, Wednesday ..Commencement, 11 A. M.
June 22, ThursdayRegistration of Candidates for Admission
by Examination: 9 A. M.
June 22, ThursdayEntrance Examinations: 9 A. M.
June 22, ThursdayRe-examination of Conditioned Students,
9 A. M.
July 10, MondaySummer School Session begins: 9 A. M.
Aug. 19, SaturdaySummer School Session ends: 6 P. M.

SUMMER RECESS.

- Sept. 18, MondayRegistration of Candidates for Admission
by Examination: 9 A. M. to 11 A. M.
Sept. 18, MondayEntrance Examinations: 9 A. M.
Sept. 19, TuesdayRe-examination of Conditioned Students:
9 A. M.
Sept. 26, 27, 28Registration and Advising of Students:
Sept. 29, FridaySession begins:

UNIVERSITY OF PENNSYLVANIA.

CHRONOLOGICAL TABLE.

- 1740—"Charity School" founded.
1749—The "Academy" established, with which the Charity School was combined.
1753—Charter granted by Thomas and Richard Penn, incorporating "The Academy and Charitable School."
1755—"Confirmatory Charter" granted by Thomas and Richard Penn, incorporating "The College, Academy and Charitable School."
1765—School of Medicine founded.

From September, 1777, to June, 1778, owing to the occupation of Philadelphia by British troops, recitations and lectures were suspended.

- 1779—Withdrawal of the chartered rights and privileges of The College by the State Assembly, and incorporation of the "University of the State of Pennsylvania."
1789—Restoration of its chartered rights and privileges to The College.
1790—Law School founded (re-established in 1850).
1791—Union of the University of the State of Pennsylvania with The College, under the title of the UNIVERSITY OF PENNSYLVANIA.
1874—University Hospital established.
1875—Towne Scientific School founded.
1877—Department of Music established.
1878—School of Dentistry founded.
1881—Wharton School of Finance and Commerce founded.
1882—Graduate School founded.
1884—Veterinary School founded.
1885—Veterinary Hospital established.
1885—Department of Physical Education established.
1889—Department of Archaeology established.
1892—Laboratory of Hygiene established.
1892—Wistar Institute of Anatomy and Biology established.
1892—Saturday Courses for Teachers established.

- 1896—Houston Club organized.
 - 1896—Flower Astronomical Observatory opened.
 - 1904—Summer School (College) established.
 - 1906—College Courses for Teachers established.
 - 1910—Henry Phipps Institute transferred to the University.
 - 1912—Division of the College into three departments—The College, the Towne Scientific School, and the Wharton School.
 - 1914—The School of Education established.
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HISTORICAL SKETCH.

On November 13, 1749, soon after the publication of a pamphlet written by Benjamin Franklin, and entitled "Proposals relating to the Education of Youth in Pensilvania," twenty-four public-spirited citizens of Philadelphia associated themselves for the purpose of establishing an Academy, and "laying a Foundation for Posterity to erect a Seminary of Learning more extensive and suitable to their future Circumstances." One of their first acts was to negotiate for the possession of a building constructed under a trust established in 1740, and intended to be used for a "Charity School" and as a "House of Publick Worship." This building had been used for the second purpose as early as November, 1740, when the celebrated Whitefield first preached in it; but the charity school had never been set in operation. The Trustees, recognizing the opportunity to have the full purpose of their trust carried out, and "in order that said building may at length be applyed to the good and pious uses originally intended," conveyed it on February 1, 1750, to the Trustees of the Academy by an Indenture, which bound the latter to place, erect, found, establish, or keep a "House of Publick Worship" and also "one free school for the instruction, teaching and education of poor children or scholars within two years from the date of these presents"; and which further provided that they "shall have full power to found, erect, establish and continue in and upon the said house and premises such other school, Academy, college or other seminary of learning" as should not conflict with the original objects of the elder trust. Under these agreements—which in due time were faithfully fulfilled—the Trustees of the Academy took possession of the "New Building," as it was then called, fitted it up for its enlarged uses, engaged a Rector and subordinate instructors, and formally opened the Academy in the presence of a distinguished company on January 7, 1751. So successful was the undertaking that in 1753 the Trustees secured a Charter for the Academy.

Under the skilful training of the learned Rev. William Smith, the highest class in this Academy attained that proficiency which, in a College course, would entitle it to a Degree. Accordingly, two years later the Proprietaries were again petitioned to convert the Academy into a College with the power of conferring collegiate degrees. The petition was granted.

The First Commencement was held May 17, 1757, when Paul Jackson, Jacob Duché, Francis Hopkinson, Samuel Magaw, Hugh Williamson, James Latta, and John Morgan received the Degree of Bachelor of Arts. In the agitated times that followed, during the wars with the French, the Provost, Mr. Smith, opposed so vehemently the non-resistance policy of the legislature of Pennsylvania, that by an arbitrary stretch of power he was thrown into prison. In faithfulness to his duties as Provost, however, he received his classes in gaol, and continued his instructions to them there while still a prisoner. Finally he was set at liberty, for the purpose of going to England to make a personal appeal to the king, and his kindly reception there was not lessened by the strain to which his loyalty at home had been put. Oxford conferred on him the Degree of Doctor of Divinity. On his return home so highly did his fellow-citizens rate his influence abroad, that when in 1761 the Trustees were hard bestead, they sent him back to England to raise funds for an endowment. It happened that King's College (now Columbia) in New York was in similar straits, and had resolved on similar efforts. The two commissioners met in England and amicably resolved to "divide the land between them" and share the proceeds. Through the influence of the Archbishop of Canterbury they received a circular letter from the king to all the churches, and succeeded in raising a very considerable endowment for each college.

On Dr. Smith's return, as it appears on the minutes of the 14th of June, 1764, a letter was received from the Archbishop of Canterbury, Thomas and Richard Penn, and the Rev. Samuel Chandler, D.D., addressed to the Trustees, in which the Trustees are congratulated on the success of Dr. Smith's, the Provost's, collection in England, and advised of what would be further necessary to the due improvement of the collection and the future prosperity of the institution. "That the institution was originally founded and carried on for the general benefit of a mixed body of people—that on the king's brief it is represented as a seminary that would be of great use for securing capable instructors and teachers, as well for the service of the society for propagating the gospel in foreign parts, as for other protestant denominations in the colonies.—That at the time of making the collection, the Provost was a clergyman

of the Church of England—the Vice-Provost, a Presbyterian—a principal professor, a Baptist, with other useful professors and tutors, all carrying on the education of youth with great harmony, and people of various denominations have heretofore contributed liberally and fully.—That jealousies had arisen lest the foundation should be narrowed, and some party exclude the rest, or put them on a worse footing than they have been or were at the time of the collection, which would be unjust and productive of contentions unfriendly to religion.” It was therefore recommended to the Trustees, by the writers of the letter (who had a principal share in procuring the collection), to make a fundamental rule or declaration, to prevent inconvenience of this kind, and in doing which, they were advised that the more closely they kept in view the plan on which the seminary was at the time of the royal brief, and on which it was carried on from the beginning, so much the less cause would any party have to be dissatisfied.

A committee having been appointed to frame a fundamental *Resolve* or declaration, in consequence of the letter, the following was reported and adopted:

“The trustees being ever desirous to promote the peace and prosperity of this seminary, and to give satisfaction to all its worthy benefactors, have taken the above letter into their serious consideration, and perfectly approving the sentiments therein contained, do order the same to be inserted in their books, that it may remain perpetually *declaratory* of the present wide and excellent plan of this institution, which hath not only met with the approbation of the great and worthy personages above mentioned, but even the royal patronage of his majesty himself. They further *declare* that they will keep this plan closely in their view, and use their *utmost endeavors* that the same *be not narrowed*, nor the members of the church of England, or those dissenting from them (*in any future election to the principal offices mentioned in the aforesaid letter*), be put on *any worse footing* in this seminary, than they were *at the time of obtaining the royal brief*. They subscribe this with their names, and ordain that the same be read and subscribed by every new trustee that shall hereafter be elected, before he takes his seat at the board.”

Perhaps no more striking instance can be given of the distortion to which men’s minds were subject in those days of political commotion, than the fact that in 1779 this resolution was construed by the legislature into a “narrowing of the foundation,” and seized as a pretext for confiscating all the rights and properties of the College, which were bestowed upon a new organization called in its charter the “Trustees of the University of the State of Penn-

sylvania." Ten years later, these rights and properties were all restored, and in 1791 an act was passed amalgamating the old College with the new University, under the title of the University of Pennsylvania.

The University of Pennsylvania comprehends the following divisions:

THE COLLEGE.

THE TOWNE SCIENTIFIC SCHOOL, including

THE COURSES IN ARCHITECTURE.

THE COURSE IN CHEMICAL ENGINEERING.

THE COURSE IN CHEMISTRY.

THE COURSE IN CIVIL ENGINEERING.

THE COURSE IN ELECTRICAL ENGINEERING.

THE COURSE IN MECHANICAL ENGINEERING.

THE WHARTON SCHOOL.

THE SCHOOL OF EDUCATION.

THE GRADUATE SCHOOL.

THE LAW SCHOOL.

THE SCHOOL OF MEDICINE.

THE SCHOOL OF DENTISTRY.

THE SCHOOL OF VETERINARY MEDICINE AND HOSPITAL.

THE UNIVERSITY HOSPITAL.

THE WISTAR INSTITUTE OF ANATOMY AND BIOLOGY.

THE LABORATORY OF HYGIENE.

THE UNIVERSITY LIBRARY.

THE DEPARTMENT OF ARCHÆOLOGY.

THE FLOWER ASTRONOMICAL OBSERVATORY.

THE DEPARTMENT OF PHYSICAL EDUCATION.

PSYCHOLOGICAL CLINIC.

HENRY PHIPPS INSTITUTE.

EVENING SCHOOL OF ACCOUNTS AND FINANCE.

PROVOST:

EDGAR FAHS SMITH, PH.D., Sc.D., L.H.D., LL.D.
President *pro tempore* of the Trustees.

VICE-PROVOST:

JOSIAH HARMAR PENNIMAN, PH.D., LL.D.

CORPORATION.

**THE TRUSTEES OF THE UNIVERSITY OF
PENNSYLVANIA.**

THE GOVERNOR OF PENNSYLVANIA: President
ex-officio.

ELECTED.

- 1876. CHARLES CUSTIS HARRISON, LL.D.
- 1880. WHARTON BARKER.
- 1881. SAMUEL DICKSON, LL.D.
- 1886. HON. SAMUEL WHITAKER PENNYPACKER, LL.D.
- 1896. MORRIS JAMES LEWIS, PH.D., M.D.
- 1896. JOSEPH GEORGE ROSENGARTEN, LL.D.
- 1896. RANDAL MORGAN.
- 1898. SAMUEL FREDERIC HOUSTON.
- 1901. JOSEPH LEVERING JONES, LL.D.
- 1903. ROBERT GRIER LE CONTE, M.D.
- 1903. JOSHUA BERTRAM LIPPINCOTT.
- 1905. ARTHUR LATHAM CHURCH.
- 1906. GEORGE HARRISON FRAZIER.
- 1910. JOHN CADWALADER, LL.D.
- 1910. CHARLES LOUIS BORIE, JR.
- 1910. LOUIS CHILDS MADEIRA.
- 1911. EDWARD TOWNSEND STOTESBURY.
- 1911. EFFINGHAM BUCKLEY MORRIS.
- 1911. GEORGE WHARTON PEPPER, D.C.L., LL.D.
- 1911. SAMUEL GIBSON DIXON, M.D., LL.D.
- 1911. MORRIS LEWIS CLOTHIER, LL.D.
- 1911. HON. JOHN CROMWELL BELL, LL.D.
- 1911. JAMES WILLIAM WHITE, M.D., PH.D., LL.D.
- 1911. RICHARD ALEX. FULLERTON PENROSE, JR., PH.D.

SECRETARY OF THE CORPORATION,
EDWARD ROBINS, A.M.

UNIVERSITY OF PENNSYLVANIA CABLE ADDRESS:

"Sylpenn," Philadelphia

ADMINISTRATIVE OFFICERS.

OF THE CORPORATION.

Provost—EDGAR F. SMITH, PH.D., Sc.D., L.H.D., LL.D.

Office in the John Harrison Laboratory of Chemistry, Thirty-fourth and Spruce Streets.

Vice-Provost—JOSIAH H. PENNIMAN, PH.D., LL.D.

Office, 104 College Hall.

Secretary—EDWARD ROBINS, A.M.

Office, 4 Law School Building.

Treasurer—WILLIAM H. HUTT, JR.

Office, 400 Chestnut Street.

Recorder—GEORGE E. NITZSCHE, LL.B.

Office, Houston Hall.

Bursar—WILLIAM O. MILLER, A.B.

Office, 102 College Hall. Office hours, 9 A. M. to 5 P. M., daily. The Bursar's office is open from 8.45 A. M. to 5 P. M. Saturdays, 8.45 A. M. to 1 P. M.

OF THE TOWNE SCIENTIFIC SCHOOL.

Dean of the Towne Scientific School Faculty—JOHN FRAZER, A.M., PH.D.

Office, Engineering Building. Office hours, 9 A. M. to 12 M. daily and 3 P. M. to 4 P. M., except Saturdays.

OF THE DEPARTMENT OF PHYSICAL EDUCATION.

Director—R. TAIT MCKENZIE, A.B., M.D.

Office in the Gymnasium, Thirty-third and Spruce Streets. Office hours, 3 P. M. to 6 P. M., daily, except Saturdays.

Students' Physicians—The Trustees have appointed DRs. G. L. DEWALD, GEORGE WILSON and J. C. BIRDSALL to act as students' physicians, under the guidance of the Physician-in-Chief of the Medical Dispensary of the University Hospital.

Ophthalmologist—WILLIAM C. POSEY, A.B., M.D., 2049 Chestnut Street.

Office hours, from 8.30 A. M. to 1 P. M., daily. Telephone connection.

TOWNE SCIENTIFIC SCHOOL.

STANDING COMMITTEES.

1. EXECUTIVE COMMITTEE.—The Dean, Chairman; Professor Laird, Professor Marburg, Professor Shinn, Professor Fernald, Professor Pender.

2. DISCIPLINE.—The Dean, Chairman; Professor Easby, Professor Stanford, Assistant Professor Bickley, Assistant Professor Taggart, Assistant Professor Clewell.

THE TOWNE SCIENTIFIC SCHOOL.

FACULTY.

EDGAR F. SMITH, PH.D., Sc.D., L.H.D., LL.D., Provost, and
BLANCHARD Professor of Chemistry.

JOSIAH H. PENNIMAN, PH.D., LL.D., VICE-PROVOST, and Pro-
fessor of English Literature.

JOHN FRAZER, A.M., PH.D., DEAN OF THE TOWNE SCIENTIFIC
SCHOOL, and Assistant Professor of Chemistry.

FELIX E. SCHELLING, A.M., PH.D., LITT.D., LL.D., JOHN WELSH
CENTENNIAL Professor of History and English Literature.

*ARTHUR W. GOODSPEED, PH.D., Professor of Physics, and
Director of the Randal Morgan Laboratory of Physics.

EDWIN S. CRAWLEY, PH.D., THOMAS A. SCOTT Professor of
Mathematics.

GEORGE E. FISHER, A.M., PH.D., Professor of Mathematics.

WARREN P. LAIRD, Sc.D., Professor of Architecture.

EDGAR MARBURG, C.E., Sc.D., Professor of Civil Engineering.

AMOS P. BROWN, E.M., PH.D., Professor of Mineralogy and
Geology.

HERBERT E. EVERETT, Professor of the History of Art.

ALEXANDER C. ABBOTT, M.D., Dr.P.H., Sc.D., Professor of
Hygiene and Bacteriology.

ISAAC J. SCHWATT, PH.D., Professor of Mathematics.

WILLIAM EASBY, JR., C.E., Professor of Municipal Engineering.

J. VERNE STANFORD, B.S., M.E., Professor of Mechanical En-
gineering.

DAVID H. BERGEY, A.M., M.D., Assistant Professor of Bacter-
iology.

PAUL P. CRET, Arch. Diplômé du Gouvernement Français, O.A.,
Sc.D., Professor of Design.

EDWARD C. WESSELHOEFT, A.M., Professor of German.

HORACE C. RICHARDS, PH.D., Professor of Mathematical
Physics.

GEORGE H. HALLETT, A.M., PH.D., Professor of Mathematics.

ARTHUR H. QUINN, PH.D., Professor of English.

ERIC DOOLITTLE, C.E., FLOWER Professor of Astronomy.

CORNELIUS WEYGANDT, PH.D., Professor of English Litera-
ture.

*Absent on leave.

GEORGE W. DAWSON, Professor of Drawing.

THOMAS NOLAN, PH.B., M.S., A.M., Professor of Architectural Construction.

HENRY B. EVANS, M.E., PH.D., Professor of Mathematics.

R. TAIT MCKENZIE, A.B., M.P.E., M.D., Professor of Physical Education, Director of the Department of Physical Education.

OWEN L. SHINN, PH.D., Assistant Professor of Chemistry.

WALTER T. TAGGART, PH.D., Assistant Professor of Chemistry.

JOHN J. MORRIS, Professor of Mechanical Constructive Practice.

FREDERICK EHRENFELD, PH.D., Assistant Professor of Geology and Mineralogy.

HORACE P. FRY, B.S. in E.E., Assistant Professor of Mechanical Drawing.

HENRY E. EHLERS, B.S. in M.E., Professor of Experimental Engineering.

EDWARD L. INGRAM, C.E., Professor of Railroad Engineering and Geodesy.

FREDERICK H. SAFFORD, A.M., PH.D., Assistant Professor of Mathematics.

HERMAN C. BERRY, A.B., B.S. in C.E., Professor of Materials of Construction.

WILLIAM C. H. SLAGLE, C.E., Assistant Professor of Descriptive Geometry and Drawing.

ALFRED H. GUMAER, B.S. in Arch., Assistant Professor of Architectural History.

HAROLD C. BARKER, A.M., PH.D., Assistant Professor of Physics.

PHILIP R. WHITNEY, B.S. in Arch., Assistant Professor of Graphics.

THOMAS P. McCUTCHEON, JR., PH.D., Assistant Professor of Chemistry.

MAURICE J. BABB, PH.D., Assistant Professor of Mathematics.

THOMAS D. O'BOLGER, A.M., PH.D., Assistant Professor of English.

GEORGE G. CHAMBERS, PH.D., Assistant Professor of Mathematics.

OLIVER E. GLENN, A.M., PH.D., Professor of Mathematics.

LEON ARNAL, A.D.G.F., Assistant Professor of Design.

WILLIAM S. PARDOE, B.A.Sc., Assistant Professor of Civil Engineering.

EDWARD T. GRANDLIENARD, C.E., Assistant Professor of Civil Engineering.

JAMES PYLE WICKERSHAM CRAWFORD, PH.D., Professor of Romanic Languages and Literatures.

- ROBERT H. FERNALD, B.M.E., M.E., A.M., PH.D., Dynamical Engineering, Professor-in-Charge.
- LEWIS P. SHANKS, A.M., PH.D., Assistant Professor of French.
- THOMAS DARLINGTON COPE, A.B., Assistant Professor of Physics.
- ENGELHARDT AUGUST ECKHARDT, B.S., PH.D., Assistant Professor of Physics.
- HIRAM S. LUKENS, B.S. in Chem., PH.D., Assistant Professor of Chemistry.
- CHARLES W. STORK, A.M., PH.D., Assistant Professor of English.
- PERCY V. D. SHELLY, A.M., PH.D., Assistant Professor of English.
- MELVIN R. HARKINS, A.B., PH.D., Assistant Professor of Physics.
- DICRAN H. KABAKJIAN, M.S., PH.D., Assistant Professor of Physics.
- GEORGE H. BICKLEY, B.S. in Arch., A.D.G.F., Assistant Professor of Design.
- HOWARD H. MITCHELL, PH.D., Assistant Professor of Mathematics.
- SAMUEL G. BARTON, A.B., PH.D., Assistant Professor of Astronomy.
- PAUL A. DAVIS, 3d, B.S., A.D.G.F., Acting Professor of Design.
- EDGAR V. SEELER, A.M., Acting Professor of Design.
- JOHN V. VAN PELT, A.D.G.F., Acting Professor of Design.
- HAROLD PENDER, A.B., PH.D., Professor in Charge, Electrical Engineering.
- CLARENCE E. CLEWELL, E.E., Assistant Professor of Electrical Engineering.
-

- DANIEL L. WALLACE, Instructor in Analytical Chemistry.
- EDWIN M. FOGEL, PH.D., Instructor in German.
- CHARLES W. BLOEMKER, Instructor in Forging.
- FREDERIC ANTHONY CHILD, A.M., Instructor in Public Speaking.
- JOHN F. MURPHY, Instructor in Foundry Work.
- CHARLES TRAVIS, PH.D., Instructor in Geology and Mineralogy.
- PERCIVAL R. HALL, Instructor in Iron-working.
- WALTER M. BOEHM, B.S., PH.D., Instructor in Physics.
- ROBERT H. KREWSON, Instructor in Iron-working.

- LOUIS O'SHAUGHNESSY, C.E., A.M., PH.D., Instructor in Mathematics.
- GEORGE W. PLUMMER, PH.D., Instructor in Chemistry.
- GEORGE W. H. FAWKES, Instructor in Wood-working.
- SAMUEL APPLIN, Instructor in Iron-working.
- ELMER BARK, B.S., Instructor in Mechanical Engineering.
- WILLIAM P. HARBESON, B.S., LL.B., Instructor in English.
- JOHN C. MENDENHALL, A.M., Instructor in English.
- STANLEY P. SHUGERT, A.M., Instructor in Mathematics.
- THOMAS R. ALEXANDER, JR., A.M., Instructor in Chemistry.
- WILLIAM I. BOOK, B.S., PH.D., Instructor in Physics.
- GEORGE W. McCLELLAND, A.M., Instructor in English.
- JOSEPH R. FITZPATRICK, A.M., Instructor in Chemistry.
- CLEMENT E. FOUST, A.M., Instructor in English.
- MILTON S. GRAWL, Instructor in Mechanical Drawing.
- CHESLEY H. JOHNSON, M.E., Instructor in Electrical Engineering.
- ROBERT R. McGOODWIN, M.S. in Arch., Instructor in Design.
- C. LAURENCE WARWICK, B.S. in C.E., Instructor in Civil Engineering.
- AMANDUS JOHNSON, A.M., PH.D., Instructor in German and Scandinavian Languages.
- JOHN H. MÜLLER, M.S., A.M., PH.D., Instructor in Chemistry.
- ORLAND R. SWEENEY, A.M., Instructor in Chemistry.
- WILLIAM T. LEGGO, B.S. in C.E., C.E., Instructor in Civil Engineering.
- KARL H. FUSSLER, A.B., Instructor in Physics.
- JOHN DOLMAN, JR., B.S., A.M., Instructor in English and Forensics.
- CHARLES B. BAZZONI, B.Pd., B.S., A.M.,* Instructor in Physics.
- CHARLES E. MEYERS, A.M., Instructor in English.
- ROBERT L. MOORE, B.S., A.M., PH.D., Instructor in Mathematics.
- FRANK M. REGISTER, B.S. in C.E., Instructor in Civil Engineering.
- WILLIAM B. LEIGHNINGER, A.M., Instructor in Chemistry.
- JOSEPH L. MOUNCE, Instructor in Wood-working.
- FREDERICK W. BEAL, A.M., PH.D., Instructor in Mathematics.
- JESSE B. STRAW, B.S. in E.E., Instructor in Electrical Engineering.
- GEORGE S. WHEATLEY, B.S. in M.E., Instructor in Mechanical Engineering.
- HERBERT A. BLOGG, Spec. Cert., Assistant in Architecture.
- LOUIS W. ROBEY, A.B., LL.B., Lecturer on Business Law.

JAMES B. LICHTENBERGER, A.B., LL.B., Lecturer on Business Law.

FRANK A. LAURIE, JR., B.S., Instructor in French.

RALPH W. DUNCAN, PH.D., Instructor in Physics.

ROBERT C. DUNCAN, PH.D., Instructor in Physics.

OTTO STUHLMANN, JR., A.M., PH.D., Instructor in Physics.

LOUIS K. OPPITZ, A.M., Instructor in Physics.

GEORGE E. CROFOOT, B.S. in M.E., Instructor in Mechanical Engineering.

JOHN F. ALLISON, B.S., M.E., Instructor in Mechanical Drawing.

CHARLES A. JOHNSON, B.S. in M.E., Instructor in Mechanical Drawing.

GEORGE W. ARNOLD, JR., Assistant in Mechanical Drawing.

HARRY E. PARKER, M.S. in Arch., Instructor in Architectural Construction.

HERBERT H. VAUGHAN, A.B., PH.D., Instructor in Romanic Languages.

NORMAN V. BUREAU, B.S. in C.E., Instructor in Civil Engineering.

WILLIAM R. FISHER, Assistant in Civil Engineering.

LEWIS B. HESSLER, A.M., Instructor in English.

ADOLF GELPKE, Assistant in Mechanical Drawing.

W. POWELL ROBINS, A.D.G.F., Instructor in Design.

LEICESTER B. HOLLAND, B.S. in Arch., Instructor in Architecture.

WILMER B. RABENOLD, Assistant in Freehand Drawing.

HERBERT S. HARNED, A.B., B.S. in Chem., PH.D., Instructor in Physical Chemistry.

ELVAH H. GRAFTON, M.S., Instructor in Chemistry.

ROBERT S. JOHNSTON, B.S. in C.E., Instructor in Civil Engineering.

THOMAS WICKS, Instructor in Civil Engineering.

FRANK G. DEKER, B.S. in C.E., Instructor in Civil Engineering.

MARVIN Y. NEELY, B.S., B.S. in C.E., Instructor in Civil Engineering.

MYRLE C. EVANS, B.S. in M.E., Instructor in Mechanical Engineering.

GEORGE E. HAGEMANN, B.S. in M.E., Instructor in Mechanical Engineering.

PAUL J. KIEFER, A.B., B.S. in M.E., Instructor in Mechanical Engineering.

LELAND W. BENNETT, B.S. in E.E., Instructor in Drawing and Design.

RALPH J. DALY, B.S. in E.E., Instructor in Electrical Engineering.

- CHARLES D. FAWCETT, B.S. in E.E., Instructor in Electrical Engineering.
- WILLIAM F. JOHNSON, B.S. in E.E., Instructor in Electrical Engineering.
- ROY KEGERREIS, M.E. in E.E., Instructor in Electrical Engineering.
- PAUL C. KITCHEN, PH.D., Instructor in English.
- HENRY D. LEARNED, A.B., Instructor in German.
- CARL E. MARQUARDT, A.M., Assistant in German.
- ALBERT E. TROMBLY, A.B., Instructor in French.
- HOWARD M. TRUEBLOOD, B.S., PH.D., Instructor in Electrical Engineering.
- HENRY F. SMYTH, M.D., Dr.P.H., Instructor in Hygiene and Bacteriology.
- OTHO L. THOMAS, B.S., Assistant in Chemistry.
- JOHN F. HOUCK, B.S., Assistant in Chemistry.
- CHRISTIAN C. SCHLUDERBERG, M.E., Instructor in Mechanical Engineering.
- HAROLD S. ORR, M.E., Instructor in Mechanical Engineering.
- GEORGE B. WHAREN, B.S. in M.E., M.E., Instructor in Mechanical Engineering.
- SHERILL S. RATHBUN, A.B., M.E., Instructor in Mechanical Engineering.
- THORNTON OAKLEY, M.S., Assistant in Freehand Drawing.
- W. POPE BARNEY, M.S. in Arch., Assistant in Design.
- JOHN F. HARBESON, B.S., M.S. in Arch., Assistant in Design.
- JAMES H. CHILLMAN, JR., M.S. in Arch., Assistant in Freehand Drawing.
- EDWARD G. CONRAD, M.S., in Arch., Assistant in Freehand Drawing.
- VAN HORN D. WOLFE, A.B., Assistant in Architectural Construction.
- HERBERT F. EVERETT, Assistant in Architecture.
- RAYMOND J. RICHARDSON, B.S. in Arch., Assistant in Architecture.
- GEORGE W. BAUMEISTER, Reader in Architecture.
- EDMUND B. TAZEWELL, Reader in Architecture.
- ERNST C. P. METZENTHIN, A.M., Assistant in German.
- KARL SCHOLZ, B.S., Assistant in German.
- WILLIAM F. KAMMAN, A.M., Assistant in German.
- LOWELL J. REED, M.S., Instructor in Mathematics.
- VINCENZO DI SANTO, A.B., Instructor in French.
- PHILIP E. DOUGLASS, A.B., Instructor in French.
- EDWARD D. McDONALD, A.M., Instructor in English.

BERTRAM C. SCHMITT, B.S., Instructor in English.

EDWIN R. MARTIN, B.S. in E.E., Instructor in Electrical Engineering.

ROBERT B. FINLEY, B.S. in E.E., E.E., Instructor in Electrical Engineering.

ABEL H. HILLMAN, B.S. in C.E., Instructor in Civil Engineering.

ROSS W. RITTER, B.S. in C.E., Instructor in Civil Engineering.

DONALD S. MacBRIDE, Assistant in Civil Engineering.

REQUIREMENTS FOR ADMISSION.

"A unit represents a year's study in any subject in a secondary school, constituting approximately a quarter of a full year's work."

(This statement is designed to afford a standard of measurement for the work done in secondary schools. It takes the four-year high school course as a basis and assumes that the length of the school year is from thirty-six to forty weeks, that a period is from forty to sixty minutes in length, and that the study is pursued for four or five periods a week; but, under ordinary circumstances, a satisfactory year's work in any subject cannot be accomplished in less than one hundred and twenty sixty-minute periods, or their equivalent. It further assumes that two hours of drawing, manual training or laboratory work are equivalent to one hour of classroom work. Schools organized on a different basis can nevertheless estimate their work in terms of this unit.)

Architecture.

Subjects	Units
English	3
History	1
Math. A	1½
" C	1
" D	½
Physics A.....	½
French A or German A...	2
Electives	5
Total	14½

C.E. M.E. E.E. Ch.E. or Chemistry.

Subjects	Units
English	3
History	1
Math. A	1½
" C	1
" D	½
" E	0*
" F	½
Physics A.....	½
French A or German A...	2
Electives	4½

Total 14½

*Math. E is required, unless F is offered, but no credit is given.

SUBJECTS ACCEPTED FOR ADMISSION.

Subjects	Units
English A—Grammar and Composition.....	1½
English B—General and Specific Reading	1½
English—Extra	1
Mathematics A1—Algebra, to Quadratics.....	1
Mathematics A2—Algebra, Quadratics and Beyond.....	½
Mathematics B—Higher Algebra.....	½
Mathematics C—Plane Geometry.....	1
Mathematics D—Solid Geometry.....	½
Mathematics E—Rudiments of Plane Trigonometry.....	0
Mathematics F—Plane Trigonometry	½
History A—Ancient	½ or 1*
History B—Medieval and Modern.....	½ or 1*
History C—English	½ or 1*
History D†—American History and Civil Government....	½ or 1*
Civil Government†	½ or 1*
‡Latin A—Grammar and Elementary Prose Composition..	1
Latin B—Cæsar and Elementary Sight Translation of Prose	1
Latin C—Cicero and Advanced Sight Translation of Prose	} 1
Latin L—Advanced Prose Composition	
Latin D—Virgil and Sight Translation of Poetry.....	1
‡Greek B—Xenophon, Anabasis, Bks. I-IV.....	1
Greek F—Prose Composition.....	½
Greek G—Sight Translation of Prose.....	½
Greek C—Homer, Iliad. Bks. I-III.....	1
‡German A—Elementary German.....	2
German B—Intermediate German.....	1
German C—Advanced German.....	1
‡French A—Elementary French.....	2
French B—Intermediate French.....	1
French C—Advanced French	1
‡Spanish A—Elementary Spanish.....	2
Spanish B—Intermediate Spanish.....	1
‡Italian A—Elementary Italian.....	2
Italian B—Intermediate Italian.....	1
Physics A—Elementary Physics without Laboratory Work	½
Physics B—Elementary Physics with Laboratory Work...	1

*Either one-half or one unit may be granted upon school record. The entrance examination in this subject will cover the preparation necessary for one full unit.

†History D and Civil Government may at most, count one and a half units.

‡Not less than two units of a foreign language will be accepted.

Subjects	Units
Chemistry	1
Botany	½ or 1*
Zoölogy	½ or 1*
Biology	1
Physiology	½ or 1*
Physical Geography or Physiography	½ or 1*
Geology	½ or 1*
Astronomy	½ or 1*
Economics	½ or 1*
Business Law	½ or 1*
Commercial Geography	½ or 1*
Drawing	½ or 1*
Manual Training	½ or 1*

VACCINATION.

According to the Regulations of the Bureau of Health of the City of Philadelphia, the University of Pennsylvania is required to refuse admission to any person except upon a certificate signed by a physician stating that such person has been recently vaccinated or that he or she has previously had smallpox. All persons matriculating in the College will, therefore, have to present such a certificate at the time of matriculation and in default of such certificate must be vaccinated. Official forms furnished by the Bureau of Health of the City of Philadelphia can be obtained by applying in person or by messenger at Room 712, City Hall, between the hours of 9 A. M. and 4 P. M., and on Saturdays from 9 A. M. to 12 M., or at the office of the Dean, Engineering Building.

METHODS OF SATISFYING REQUIREMENTS.

Candidates for admission to the Freshman Class in the Towne Scientific School may satisfy the scholastic requirements for admission either (1) by passing the entrance examinations, or (2) by showing by *records of their work* that they have covered these requirements in a manner satisfactory to one of the Committees on Admission.

All communications regarding admission to the regular courses in the Towne Scientific School should be addressed to the Chairman of

*Either one-half or one unit may be granted upon school record. The entrance examination in this subject will cover the preparation necessary for one full unit.

the Committee on the Admission of Regular Students, College Hall, University of Pennsylvania.

I. ADMISSION BY EXAMINATION.—Candidates may attend either the examinations conducted by the University in Philadelphia or the examinations of the College Entrance Examination Board. The University conducts entrance examinations in Philadelphia in January, June and September. For schedule of the entrance examinations, see pages 49 to 52.

The University of Pennsylvania does not give its examinations at places outside of Philadelphia.

Candidates for admission wishing to be examined away from Philadelphia should take the examinations of the College Entrance Examination Board.

COLLEGE ENTRANCE EXAMINATION BOARD.—The entrance examinations of the College Entrance Examination Board will be held June 14-19, 1915. Applications for examination must be addressed to the College Entrance Examination Board, Post Office Sub-Station 84, New York, N. Y., and must be made upon a form obtained from the Secretary of the Board. Applications for examination at points in the United States east of the Mississippi River, also at points on the Mississippi River, must be received by the Secretary of the Board at least two weeks in advance of the examinations, that is, on or before Monday, May 31, 1915; applications for examination elsewhere in the United States or in Canada, must be received at least three weeks in advance of the examinations, that is, on or before Monday, May 24, 1915; and applications for examination outside of the United States and Canada, must be received at least five weeks in advance of the examinations, that is, on or before Monday, May 10, 1915.

PRELIMINARY EXAMINATIONS.—Candidates may present themselves at any of the regular examinations held not more than two years and four months in advance of their admission to College for examination in any portion of the subjects required for admission to the course they propose to enter.

CERTIFICATES OF PREPARATION.—Every candidate must present at the time of the examination, either a certificate previously issued by an Admission Committee, or a certificate from the head-master of his school, or from his tutor, naming the subjects in which he is prepared. Blank certificates for the latter purpose may be obtained on application. When a candidate, however, has been in regular attendance at a school or academy during the year preceding his application for admission to an examination, a certificate from a private tutor will not in itself be sufficient.

II. ADMISSION UPON SCHOOL RECORD.—Graduates of accredited schools may receive credit without examination for the entrance requirements in whole (except English A) or in part. A statement of the candidate's school record, on a blank provided for the purpose and certified by the Principal of the school, is required to be sent to the Chairman of the Committee on Admission of Regular Students.

The fact that candidates from a given school may have previously been admitted on their records does not establish any right to which a candidate may appeal for the acceptance of his own record. The case of each individual is decided absolutely on its own merits.

All applications for admission upon school record should be in the hands of the Chairman of the Admission Committee as early as possible in June; should this, for good reasons, be impossible, then not later than September 1st. *Principals of schools will appreciate the importance of sending in the applications of candidates at as early a date as possible, when they understand that until the credentials are acted upon, and the decision announced, candidates will not know in what subjects they will be required to take examinations.*

The candidate must not fail to appear at the September examinations if he has not been informed of the decision in his case before the date when the examinations begin. For this date see page 49.

Schools with the result of whose work in preparing students for college the University is not familiar, must notify the Chairman of the Committee on Admission of Regular Students before May 1st in any year if they wish to have students apply for admission in that year on their school record.

The College Entrance Diploma or the Academic Diploma issued by the New York State Education Department will be accepted for admission to the Towne Scientific School for such subjects as it covers, except English A (Grammar and Composition).

DESCRIPTION OF THE SUBJECTS ACCEPTED FOR ADMISSION.

Subjects	Units
English A—Grammar and Composition.....	1½
English B—General and Specific reading	1½
English Extra.....	1

All students entering the Towne Scientific School will be required to pass an examination in English A. No school record will be accepted in lieu of that examination.

The extra unit cannot be obtained by examination, but will be granted to candidates who present four years of satisfactory work in English of five periods a week, of a minimum length of forty minutes each.

REQUIREMENTS FOR 1915-1919.

No candidate will be accepted in English whose work is notably defective in spelling, punctuation, idiom or division into paragraphs.

A. (1) *Grammar, and Analysis of Sentences*, as in any advanced course in English Grammar and Analysis, (1) counts as 50% of English (A) and where notably deficient may exclude the applicant from credit in that subject.

(2) The writing of a short theme on a subject to be selected from a list that will be submitted to the student at the time of examination. This theme will be rated according to its correctness in spelling, punctuation, grammar, paragraph-structure and expression.

B. (1) *General Reading*.—The candidate will be required to submit a list of the books read in preparation, certified by the Principal of his school, or if the school is accredited at the University, a certificate from the Principal stating that the books for general reading have been completed as prescribed.

With a view to large freedom of choice, the books provided for reading are arranged in the following groups, from each of which at least two selections are to be made, except as otherwise provided under Group I.

GROUP I. CLASSICS IN TRANSLATION.

The *Old Testament*, comprising at least the chief narrative episodes in Genesis, Exodus, Joshua, Judges, Samuel, Kings, and Daniel, together with the books of Ruth and Esther; the *Odyssey*, with the omission, if desired, of Books I, II, III, IV, V, XV, XVI, XVII; the *Iliad*, with the omission, if desired, of Books XI, XIII, XIV, XV, XVII, XXI; the *Aeneid*.

The *Odyssey*, *Iliad* and *Aeneid* should be read in English translations of recognized literary excellence.

For any selection from this group a selection from any other group may be substituted.

GROUP II. SHAKESPEARE.

Midsummer-Night's Dream, *Merchant of Venice*, *As You Like It*, *Twelfth Night*, *The Tempest*, *Romeo and Juliet*, *King John*, *Richard II*, *Richard III*, *Henry V*, *Coriolanus*, **Julius Caesar*, **Macbeth*, **Hamlet*.

GROUP III. PROSE FICTION.

Malory, *Morte d'Arthur* (about 100 pages); Bunyan, *Pilgrim's Progress*, Part I; Swift, *Gulliver's Travels* (voyages to Lilliput and

*If not chosen for study under B (2).

to Brobdingnag); Defoe, *Robinson Crusoe, Part I*; Goldsmith, *Vicar of Wakefield*; Frances Burney, *Evelina*; Scott's Novels, any one; Jane Austen's Novels, any one; Maria Edgeworth, *Castle Rackrent*, or *The Absentee*; Dickens' Novels, any one; Thackeray's Novels, any one; George Eliot's Novels, any one; Mrs. Gaskell, *Cranford*; Kingsley, *Westward Ho! or Hereward, the Wake*; Reade, *The Cloister and the Hearth*; Blackmore, *Lorna Doone*; Hughes, *Tom Brown's Schooldays*; Stevenson's *Treasure Island*, or *Kidnapped*, or *Master of Ballantrae*; Cooper's Novels, any one; Poe, *Selected Tales*; Hawthorne, *The House of the Seven Gables*, or *Twice Told Tales*, or *Mosses from an Old Manse*; a collection of *Short Stories* by various standard writers.

GROUP IV. ESSAYS, BIOGRAPHY, ETC.

Addison and Steele, *The Sir Roger de Coverley Papers*, or Selections from the *Tatler* and *Spectator* (about 200 pages); Boswell, Selections from the *Life of Johnson* (about 200 pages); Franklin, *Autobiography*; Irving, Selection from the *Sketch Book* (about 200 pages), or *Life of Goldsmith*; Southey, *Life of Nelson*; Lamb, Selections from the *Essays of Elia* (about 100 pages); Lockhart, Selections from the *Life of Scott* (about 200 pages); Thackeray, Lectures on *Swift, Addison, and Steele* in the *English Humorists*; Macaulay, Any one of the following essays: *Lord Clive, Warren Hastings, Milton, Addison, Goldsmith, Frederic the Great, Madame d'Arblay*; Trevelyan, Selections from the *Life of Macaulay* (about 200 pages); Ruskin, *Sesame and Lilies*, or *Selections* (about 150 pages); Dana, *Two Years before the Mast*; Lincoln, *Selections*, including at least the two Inaugurals, the Speeches in Independence Hall and at Gettysburg, the Last Public Address, the Letter to Horace Greeley; together with a brief memoir or estimate of Lincoln; Parkman, *The Oregon Trail*; Thoreau, *Walden*; Lowell, *Selected Essays* (about 150 pages); Holmes, *The Autocrat of the Breakfast Table*; Stevenson, *An Inland Voyage and Travels with a Donkey*; Huxley, *Autobiography* and selections from *Lay Sermons*, including the addresses on *Improving Natural Knowledge, A Liberal Education, and A Piece of Chalk*; a collection of *Essays* by Bacon, Lamb, DeQuincey, Hazlitt, Emerson, and later writers; a collection of *Letters* by various standard writers.

GROUP V. POETRY.

Palgrave's *Golden Treasury (First Series)*: *Books II and III*, with special attention to Dryden, Collins, Gray, Cowper, and Burns; Palgrave's *Golden Treasury (First Series)*, *Book IV*, with special attention to Wordsworth, Keats, and Shelley (if not chosen for study under B2); Goldsmith, *The Traveller* and *The Deserted Village*;

Pope, *The Rape of the Lock*; a collection of English and Scottish Ballads, as, for example, some *Robin Hood* ballads; *The Battle of Otterburn*, *King Estmere*, *Young Beichan*, *Bewick and Grahame*, *Sir Patrick Spens*, and a selection from later ballads; Coleridge, *The Ancient Mariner*, *Christabel*, and *Kubla Khan*; Byron, *Childe Harold*, *Canto III or IV*, and *The Prisoner of Chillon*; Scott, *The Lady of the Lake*, or *Marmion*; Macaulay, *The Lays of Ancient Rome*, *The Battle of Naseby*, *The Armada*, *Ivry*; Tennyson, *The Princess*, or *Gereth and Lynette*, *Lancelot and Elaine*, and *The Passing of Arthur*; Browning, *Cavalier Tunes*, *The Lost Leader*, *How They Brought the Good News from Ghent to Aix*, *Home Thoughts from Abroad*, *Home Thoughts from the Sea*, *Incident of the French Camp*, *Hervé Riel*, *Pheippides*, *My Last Duchess*, *Up at a Villa—Down in the City*, *The Italian in England*, *The Patriot*, *The Pied Piper*, "*De Gustibus*" —, *Instans Tyrannus*; Arnold, *Sohrab and Rustum*, and *The Forsaken Merman*; selections from American Poetry, with special attention to Poe, Lowell, Longfellow, and Whittier.

B. (2) *Specific Reading and Study*.—This part of the requirement is intended as a natural and logical continuation of the students' earlier reading, with greater stress laid on the interest, the content, and the form of one selection from each of the following groups:

GROUP I. DRAMA.

Shakespeare: *Julius Caesar*, *Macbeth*, *Hamlet*.

GROUP II. POETRY.

Milton, *L'Allegro*, *Il Penseroso*, and either *Comus* or *Lycidas*; Tennyson, *The Coming of Arthur*, *The Holy Grail*, and *The Passing of Arthur*; the selections from Wordsworth, Keats, and Shelley in *Book IV* of Palgrave's *Golden Treasury* (*First Series*).

GROUP III. ORATORY.

Burke, *Speech on Conciliation with America*; Macaulay's *Two Speeches on Copyright* and Lincoln's *Speech at Cooper Union*; Washington's *Farewell Address* and Webster's *First Bunker Hill Oration*.

GROUP IV. ESSAYS.

Carlyle, *Essay on Burns*, with a selection from *Burns' Poems*; Macaulay, *Life of Johnson*; Emerson, *Essay on Manners*.

Candidates who pass the examinations of the College Entrance Examination Board in English 1 and 2 will be given credit for English A and B.

MATHEMATICS.

Subjects	Units
Math. A1—Algebra, to Quadratics	1
“ A2—Algebra, Quadratics and Beyond	$\frac{1}{2}$
“ B—Higher Algebra	$\frac{1}{2}$
“ C—Plane Geometry	1
“ D—Solid Geometry	$\frac{1}{2}$
“ E—Rudiments of Plane Trigonometry	0
“ F—Plane Trigonometry	$\frac{1}{2}$

A. ELEMENTARY ALGEBRA.

(1) *Algebra to Quadratics*.—The four fundamental operations for rational algebraic expressions. Factoring, determination of highest common factor and lowest common multiple by factoring. Fractions, including complex fractions, ratio and proportion. Linear equations, both numerical and literal, containing one or more unknown quantities. Problems depending on linear equations. Radicals, including the extraction of the square root of polynomials and of numbers. Exponents, including fractional and negative.

(2) *Quadratics and Beyond*.—Quadratic equations, both numerical and literal. Simple cases of equations with one or more unknown quantities, that can be solved by the methods of linear or quadratic equations. Problems depending on quadratic equations. The binomial theorem for positive integral exponents. The formulas for the n th term and the sum of the terms of arithmetical and geometric progressions, with applications.

B. ADVANCED ALGEBRA.—Permutations and combinations, limited to simple cases. Complex numbers, with graphical representation of sums and differences. Determinants, chiefly of the second, third and fourth orders, including the use of minors and the solution of linear equations. Numerical equations of higher degree, and as much of the theory of equations, with graphical methods, as is necessary for their treatment, including Descarte's rule of signs and Horner's method, but not Sturm's functions or multiple roots.

C. PLANE GEOMETRY.—The usual theorems and constructions of good text-books, including the general properties of plane rectilinear figures; the circle and the measurement of angles; similar polygons; areas; regular polygons, and the measurement of the circle. The solution of numerous original exercises, including loci problems. Applications to the mensuration of lines and plane surfaces.

D. SOLID GEOMETRY.—The usual theorems and constructions of good text-books, including the relations of planes and lines in space; the properties and measurement of prisms, pyramids, cylinders and cones; the sphere and the spherical triangle. The solution of numerous original exercises, including loci problems. Applications to the mensuration of surfaces and solids.

E. RUDIMENTS OF PLANE TRIGONOMETRY.—Including the definitions and relations of the six trigonometrical functions as ratios; proof of elementary formulas; theory and practice in the use of tables of logarithms; solution of right and oblique plane triangles.

F. PLANE TRIGONOMETRY.—Definitions and relations of the six trigonometric functions as ratios; circular measurement of angles. Proofs of principal formulas; in particular for the sine, cosine, and tangent of the sum and the difference of two angles, of the double angle and the half angle, the product expressions for the sum and the difference of two sines or of two cosines, etc.; the transformation of trigonometric expressions by means of these formulas. Solution of trigonometric equations of a simple character. Theory and use of logarithms (without the introduction of work involving infinite series). The solution of right and oblique triangles, and practical applications.

Candidates who pass the examination of the College Entrance Examination Board in Mathematics **A1, A2, B, C, D** or **F** will be given corresponding credit.

HISTORY.

Subjects	Units
History A —Ancient	$\frac{1}{2}$ or 1
“ B —Medieval and Modern	$\frac{1}{2}$ or 1
“ C —English	$\frac{1}{2}$ or 1
“ D —American History and Civil Government	$\frac{1}{2}$ or 1

Outline maps will be furnished for the questions in historical geography which will form a part of each paper.

A. Ancient history, with special reference to Greek and Roman history, and including also a short introductory study of the more ancient nations and the chief events of the early Middle Ages, down to the death of Charlemagne (814).

B. Medieval and modern European history, from the death of Charlemagne to the present time.

C. English history, with due reference to social and political development.

D. American history and civil government.

Details of the requirements in history will be found in the report of the Committee of Seven of the American Historical Association, published in “The Study of History in Schools” (Macmillan, 1899), and the report of the Committee of Five of the American Historical Society, “The Study of History in Secondary Schools” (Macmillan, 1911).

Candidates who pass the examination of the College Entrance Examination Board in History **A, B, C** or **D** will be given credit for the corresponding subject.

CIVIL GOVERNMENT.

Subject	Units
CIVIL GOVERNMENT	1/2 or 1

This covers the elements of the Federal Constitution.

LATIN.

Subjects	Units
Latin A —Grammar and Elementary Prose Composition.....	1
“ B —Cæsar and Elementary Sight Translation of Prose....	1
“ C —Cicero and Advanced Sight Translation of Prose..”	} 1
“ L —Advanced Prose Composition	
“ D —Vergil and Sight Translation of Poetry	

NOTE.—Questions will be asked under **B**, **C**, and **D**, on the inflection, derivation, and composition of words, on syntax, and on geography, history, and mythology.

In each paper candidates must deal satisfactorily with all parts of the examination, or no credit will be given for the paper.

A. GRAMMAR AND ELEMENTARY PROSE COMPOSITION: The inflections; the simpler rules for the composition and derivation of words; syntax of cases and the verb structure of sentences in general. Translation of Latin into simple sentences. This will count as one point for admission.

B. EASY PROSE: The amount to be read by the student shall be not less than Cæsar, *Gallic War*, I-IV; the reading shall be done in Cæsar, *Gallic War* and *Civil War*, and Nepos, *Lives*. The examination will include passages at sight.

C. ADVANCED PROSE: The amount to be read by the student shall be not less than Cicero, *Orations against Catiline, for the Manilian Law*, and *for Archias*; the reading shall be done in Cicero, *Orations, Letters*, and *De Senectute*, and Sallust, *Catiline* and *Jugurthine War*. The examinations will be upon the following prescribed reading: Cicero, *Orations for the Manilian Law* and *for Archias*, and will include also passages at sight.

L. PROSE COMPOSITION: The translation into Latin of continuous English prose based upon passages of moderate difficulty in Cæsar or Cicero.

D. POETRY: The amount to be read by the student shall be not less than Vergil, *Aeneid*, I-VI; the reading shall be done in Vergil, *Bucolics, Georgics*, and *Aeneid*, and Ovid, *Metamorphoses, Fasti* and *Tristia*. The examination will be upon the following prescribed reading: *Vergil, Aeneid*, I, II and either IV or VI at the option of the candidate, with the scansion of the dactylic hexameter, and will include also passages at sight.

Candidates who pass the examinations of the College Entrance Examination Board will be given corresponding credit, as follows:

NEW REQUIREMENTS.

1 and 2	will give	A
3	" "	B
4	" "	C
6	" "	L
5	" "	D

OLD REQUIREMENTS.

B and M	will give	B
C	" P	" C
D	" Q	" D

SUGGESTIONS CONCERNING PREPARATION.

Exercises in translation at sight should begin in school with the first lessons in which Latin sentences of any length occur, and should continue throughout the course with sufficient frequency to insure correct methods of work on the part of the student. From the outset this particular attention should be given to developing the ability to take in the meaning of each word—and so, gradually, of the whole sentence—just as it stands; the sentence should be read and understood in the order of the original, with full appreciation of the force of each word as it comes, so far as this can be known or inferred from that which has preceded and from the form and the position of the word itself. The habit of reading in this way should be encouraged and cultivated as the best preparation for all the translating that the student has to do. No translation, however, should be a mechanical metaphrase. Nor should it be a mere loose paraphrase. The full meaning of the passage to be translated, gathered in the way described above, should finally be expressed in clear and natural English.

A written examination cannot test the ear or tongue, but proper instruction in any language will necessarily include the training of both. The school work in Latin, therefore, should include much reading aloud, writing from dictation, and translation from the teacher's reading. Learning suitable passages by heart is also very useful, and should be more practised.

The work in composition should give the student a better understanding of the Latin he is reading at the time, if it is prose, and greater facility in reading. It is desirable, however, that there should be systematic and regular work in composition during the time in which poetry is read as well; for this work the prose authors already studied should be used as models.

GREEK.

Subjects	Units
Greek B —Xenophon, <i>Anabasis</i> , Bks. I-IV	1
“ F —Prose Composition	½
“ G —Sight Translation of Prose	½
“ C —Homer, <i>Iliad</i> , Bks. I-III	1

NOTE.—Questions on inflection, derivation, composition of words and on syntax will be asked under **B** and **C**.

B. XENOPHON: The first four books of the *Anabasis*.

F. PROSE COMPOSITION: Continuous prose based upon Xenophon and other Attic prose of similar difficulty.

G. SIGHT TRANSLATION OF PROSE of no greater difficulty than Xenophon's *Anabasis*.

C. HOMER: The first three books of the *Iliad* (omitting **II**, 484-end).

Candidates who pass the examination of the College Entrance Examination Board in Greek will be given corresponding credit, as follows:

A1, A2 and B will give B	
C or C H	“ “ C
F	“ “ F
G	“ “ G

GERMAN.

Subjects	Units
German A —Elementary German	2
“ B —Intermediate German	1
“ C —Advanced German	1

A. ELEMENTARY GERMAN.—The preparation for this examination should comprise: (1) Careful drill upon pronunciation; (2) the memorizing and frequent repetition of easy colloquial sentences; (3) drill upon the rudiments of grammar, that is, upon the inflection of the articles, of such nouns as belong to the language of everyday life, of adjectives, pronouns, weak verbs, and the more usual strong verbs; also upon the use of the more common prepositions, the simpler uses of the modal auxiliaries, and the elementary rules of syntax and word-order; (4) abundant easy exercises designed not only to fix in mind the forms and principles of grammar, but also to cultivate readiness in the reproduction of natural forms of expression; (5) the reading of from 75 to 100 pages of graduated texts from a reader, with constant practice in translating into German easy variations upon sentences selected from the reading lesson (the teacher giving the English), and in the reproduction from memory of sentences previously read.

During the second year the work should comprise: (1) The reading of from 150 to 200 pages of literature in the form of easy stories and plays; (2) accompanying practice, as before, in the translation into German of easy variations upon the matter read and also in the off-hand reproduction, sometimes orally and sometimes in writing, of the substance of short and easy selected passages; (3) continued drill upon the rudiments of the grammar, directed to the ends of enabling the pupil, first, to use his knowledge with facility in the formation of sentences, and, secondly, to state his knowledge correctly in the technical language of grammar.

The following reading recommended in the report of the Committee of Twelve will furnish matter from which selections may be made by the teacher: Anderson's *Märchen* and *Bilderbuch ohne Bilder*; Arnold's *Fritz auf Ferien*; Baumbach's *Die Nonna* and *Der Schwiegersohn*; Gerstäcker's *Germelshausen*; Heyse's *L'Arrabbiata*, *Das Mädchen von Treppi*, and *Anfang und Ende*; Hillern's *Höher als die Kirche*; Jensen's *Die braune Erica*; Leander's *Träumereien*, and *Kleine Geschichten*; Seidel's *Märchen*; Stökl's *Unter dem Christbaum*; Storm's *Immensee* and *Geschichten aus der Tonne*; Zschokke's *Der zerbrochene Krug*; Hauff's *Das kalte Herz*. Among shorter plays the best available are perhaps Benedix's *Der Prozess*, *Der Weiberfeind*, and *Günstige Vorzeichen*; Elz's *Er ist nicht eifersüchtig*; Wichert's *An der Majorsecke*; Wilhelm's *Einer muss heiraten*.

B. INTERMEDIATE GERMAN.—The preparation for this examination should comprise, in addition to the elementary course, the reading of about 400 pages of moderately difficult prose and poetry, with constant practice in giving, sometimes orally and sometimes in writing, paraphrases, abstracts, or reproductions from memory of selected portions of the matter read; also grammatical drill upon the less usual strong verbs, the use of articles, cases, auxiliaries of all kinds, tenses and modes (with special reference to the infinitive and subjunctive), and likewise upon word order and word-formation.

The intermediate course is supposed to be the elementary course, plus one year's work at the rate of not less than four recitations a week. Suitable reading matter for the third year can be selected from such works as the following: Freytag's *Die Journalisten*, Keller's *Fähnlein der sieben Aufrechten*, Storm's *Schimmelreiter* or C. F. Meyer's *Das Amulett*.

C. ADVANCED GERMAN.—The preparation for this examination should comprise, in addition to the elementary and intermediate

courses, the following topics, which are the equivalent of one year's work, at the rate of not less than four recitations a week:

1. Schiller's life and works, including the reading and study of one of the following dramas, *Die Braut von Messina* or *Wallenstein*.

2. The reading of about 150 pages of historical German prose, consisting of works like the following: Nichol's *Modern German Prose*, Schönfeld's *Historical German Prose*, Sybel's *Erhebung Europas*, Freytag's *Doktor Luther* or Loening and Arndt's *Deutsche Wirtschaft*.

3. Advanced Composition and Conversation, based on books like Pope's *Writing and Speaking German*.

Candidates who pass the examinations of the College Entrance Examination Board in German **A**, **B** or **C** will be given corresponding credit.

FRENCH.

Subjects	Units
French A —Elementary French	2
“ B —Intermediate French	1
“ C —Advanced	1

A. ELEMENTARY FRENCH.—Preparation for this examination should comprise (1) careful drill in pronunciation; (2) the rudiments of grammar, including the inflection of the regular and the more common irregular verbs, the plural nouns, the inflection of adjectives, particles, and pronouns; the use of personal pronouns, common adverbs, prepositions, and conjunctions; the order of words in the sentence, and the elementary rules of syntax; (3) abundant easy exercises, designed not only to fix in the memory the forms and principles of grammar, but also to cultivate readiness in the reproduction of natural forms and expression; (4) the reading of from 100 to 175 duodecimo pages of graduated texts, with constant practice in translating into French easy variations of the sentences read (the teacher giving the English), and in reproducing from memory sentences previously read; (5) writing French from dictation.

During the second year the work should comprise (1) the reading of from 250 to 400 pages of easy modern prose in the form of stories, plays, or historical or biographical sketches; (2) constant practice, as in the previous year, in translating into French easy variations upon the texts read; (3) frequent abstracts, sometimes oral and sometimes written, of portions of the text already read; (4) writing French from dictation; (5) continued drill upon the rudiments of grammar, with constant application in the construction of sentences; (6) mastery of the forms and use of pro-

nouns, of all but the rare irregular verb forms, and of the simpler uses of the conditional and subjunctive.

Suitable texts for the second year: About's *Le roi des montagnes*, Bruno's *Le tour de la France*, Daudet's easier short tales, La Bédollière's *Mère Michel et son chat*, Erckmann-Chatrian's stories, Foa's *Contes biographiques* and *Le petit Robinson de Paris*; Foncin's *Le pays de France*, Labiche and Martin's *La poudre aux yeux* and *Le voyage de M. Perrichon*, Legouvé and Labiche's *La cigale chez les fourms*, Malot's *Sans famille*, Mariet's *La tâche du petit Pierre*, Mèrimée's *Colomba*, extracts from Michelet, Sarcey's *Le siège de Paris*, Verne's stories.

B. INTERMEDIATE FRENCH.—Preparation for this examination should comprise the reading of from 400 to 600 pages of French of ordinary difficulty, a portion to be in the dramatic form; constant practice in giving French paraphrases, abstracts or reproductions from memory of selected portions of the matter read; a thorough review of grammar; writing from dictation.

Suitable texts are: About's stories, Augier and Sandeau's *Le gendre de M. Poirier*, Béranger's poems, Corneille's *Le Cid* and *Horace*, Coppée's poems, Daudet's *La Belle-Nivernaise*, La Brète's *Mon oncle et mon curé*, Madame de Sévigné's letters, Hugo's *Hernani* and *La chute*, Loti's *Pêcheur d'Islande*, Mignet's historical writings, Molière's *L'avare* and *Le bourgeois gentilhomme*, Racine's *Athalie*, *Andromaque* and *Esther*, George Sand's stories, Sandeau's *Mademoiselle de la Seiglière*, Scribe's plays, Thierry's *Récits des temps mérovingiens*, Thiers's *L'expédition de Bonaparte en Egypte*, Vigny's *La canne de jonc*, Voltaire's historical writings.

C. ADVANCED FRENCH.—Preparation for this examination should include the reading of from 800 to 1000 pages of French of average difficulty, in addition to the requirements for French **A** and **B**, selected from the chief prose writers and poets of the seventeenth, eighteenth and nineteenth centuries. This should be supplemented by a study of French literature, with a text-book in French. There should also be constant practice in translating connected passages from English into French, dictation and conversation.

Candidates who pass the examination of the College Entrance Examination Board in French **A**, **B** or **C** will be given corresponding credit.

SPANISH.

Subjects	Units
Spanish A —Elementary Spanish	2
“ B —Intermediate Spanish	1
A. The preparation for this examination should comprise: (1)	

Careful drill in pronunciation; (2) the rudiments of grammar, including the conjugation of the regular and the more common irregular verbs, the inflection of nouns, adjectives and pronouns, and the elementary rules of syntax; (3) exercises containing illustrations of the principles of grammar; (4) the reading and accurate rendering into good English of from 100 to 175 duodecimo pages of graduated texts, with translation into Spanish of easy variations of the sentences read; (5) writing Spanish from dictation.

During the second year the work should comprise: (1) the reading of from 250 to 400 pages of modern prose from different authors; (2) practice in translating Spanish into English, and English variations of the text into Spanish; (3) continued study of the elements of grammar and syntax; (4) mastery of all but the rare irregular verb forms and of the simpler uses of the modes and tenses; (5) writing Spanish from dictation; (6) memorizing of easy short poems.

Suitable texts for the second year are: Valera's *El Pájaro verde*; Alarcón's *El final de Norma*; Valdés' *José*; Galdós' *Doña Perfecta*, *Marianela*.

Candidates who pass the examinations of the College Entrance Examination Board in Spanish will be given credit in Spanish A.

B. INTERMEDIATE SPANISH.—Preparation for this examination should comprise the reading of from 500 to 600 pages of Spanish of average difficulty, in addition to the requirements for Spanish A; constant practice in translating connected passages from English into Spanish, writing from dictation and conversation. Suitable texts are: Selections from *Don Quijote*, Balsco Ibañez, *La Barraca*; Valdés, *La Hermana San Sulpicio*; Echegaray, *O Locura ó Santidad*; Nuñez de Arce, *El Haz de Leña*.

ITALIAN.

Subjects	Units
Italian A—Elementary Italian	2
“ B—Intermediate Italian	1

A. ELEMENTARY ITALIAN.—The preparation for this examination should comprise: (1) Careful drill in pronunciation; (2) the rudiments of grammar, including the conjugation of the regular and the more common irregular verbs, the inflection of nouns, adjectives and pronouns, and the elementary rules of syntax; (3) exercises containing illustrations of the principles of grammar; (4) the reading and accurate rendering into good English of from 100 to 175 duodecimo pages of graduated texts, with translation into Italian of easy variations of the sentences read; (5) writing Italian from dictation.

During the second year the work should comprise: (1) the reading of from 250 to 400 pages of modern prose from different authors; (2) practice in translating Italian into English, and English variations of the text into Italian; (3) continued study of the elements of grammar and syntax; (4) mastery of all but the rare irregular verb forms and of the simpler uses of the modes and tenses; (5) writing Italian from dictation; (6) memorizing of easy short poems.

Suitable texts: A collection of short stories of average difficulty, Goldoni, *La Locandiera* and *Il Vero Amico*; Fogazzaro, *Peregrinus*.

B. INTERMEDIATE ITALIAN.—Preparation for this examination should comprise the reading of from 500 to 600 pages of Italian, in addition to the requirements for Italian **A**: constant practice in translating connected passages from English into Italian, dictation and conversation.

Suitable texts are: Selections from Dante's *Inferno* and Tasso's *Gerusalemme Liberata*; Manzoni, *I Promessi Sposi*.

PHYSICS.

Subjects	Units
Physics A —Elementary Physics with Laboratory Work.....	½
“ B —Elementary Physics with Laboratory Work.....	1

A. This requirement is satisfied by a course of one full year as described under (a) and (b) of Physics **B** (below). Submission of a laboratory note-book is not required.

B. This is the requirement of the College Entrance Examination Board. The candidate's preparation in physics should include:

(a) The study of one standard text-book for the purpose of obtaining a connected and comprehensive view of the subject. The student should be given opportunity and encouragement to consult other scientific literature.

(b) Instruction by lecture table demonstrations to be used mainly for illustration of the facts and phenomena of physics in their qualitative aspects and in their practical applications.

(c) Individual laboratory work, consisting of experiments requiring at least the time of 30 double periods. The experiments performed by each student should number at least 30, selected from a list not very different from that given in the circular of the College Entrance Examination Board. Each student must record at least 30 experiments in the note-book and these recorded experiments must be so distributed that each main division of the subject (*e. g.*, heat, light, etc.) is adequately treated.

Details of the requirement will be found in the circular of the College Entrance Examination Board. (Address Dr. Thos. S. Fiske, Sub-station 84, New York City.)

LABORATORY NOTE-BOOK.—Every candidate must present a note-book, containing in his own language a description of his laboratory exercises, the steps, observations, and results of each exercise being carefully recorded. The record must be well-ordered, plainly legible, and concise. Simple drawings are the briefest and best descriptions of most apparatus. Mere repetitions of directions or descriptions given elsewhere should be avoided, but the note-book must afford clear evidence of the pupil's ability to make accurate observations, and to draw correct conclusions.

The note-book must contain an index of experiments, and must bear the endorsement of the teacher, such endorsement being written in ink on the inside of the cover. The endorsement must be in effect as follows:

I certify that this note-book is a true and original record of experiments actually performed by.....
in the physical laboratory of.....School
during the year 191....

.....
Teacher of Physics.

In determining the result of an examination in Physics the ratio of counts for laboratory note-book and for examination shall be as 30 is to 70.

Candidates should call for their note-books at the Admission Office about November 1st, or send postage for their return. Laboratory note-books will not in general be preserved longer than one year.

CHEMISTRY.

Subject	Units
CHEMISTRY	I

The candidate's preparation in chemistry should include:

(a) Individual laboratory work, comprising at least forty exercises selected from a list of sixty or more, not very different from the list given in the circular of the College Entrance Examination Board.

(b) Instruction by lecture-table demonstrations, to be used mainly as a basis for questioning upon the general principles involved in the pupil's laboratory investigations.

(c) The study of at least one standard text-book, to the end that the pupil may gain a comprehensive and connected view of the most important facts and laws of elementary chemistry.

Details of the requirement will be found in the circular of the College Entrance Examination Board. (Address Dr. Thos. S. Fiske, Sub-station 84, New York City.)

LABORATORY NOTE-BOOK.—Every candidate must present a properly certified and acceptable laboratory note-book. All the statements under the head of **LABORATORY NOTE-BOOK** on page 42 apply to Chemistry.

BOTANY.

Subject	Units
BOTANY	½ or 1

The preparation should comprise the structure of the cell, the formation of tissues, the general morphology, physiology and ecology of the seed, seedling and mature plant in the higher types. The broad principles governing plant classification should be thoroughly understood, and selected types similar to those recommended by the College Entrance Examination Board in Botany should be studied alike with text-book and laboratory aid. The lecture and laboratory work should be supplemented in all cases by studies made in the garden and the field. For more detailed information reference should be made to the detailed outline of study recommended by the College Entrance Examination Board.

LABORATORY NOTE-BOOK.—For one unit credit a candidate must present a properly certified and acceptable laboratory note-book. One-half unit credit may be given (on school record only) for a half year's course with an acceptable laboratory note-book. All the statements under the head **LABORATORY NOTE-BOOK** on page 42 apply to Botany.

ZOÖLOGY.

Subject	Units
ZOÖLOGY	½ or 1

Not less than two-thirds of the time is devoted to laboratory work guided by definite directions. This should be supplemented by the study of some good elementary text-book, such as Parker and Parker, *Practical Zoölogy*, Linville and Kelly, *General Zoölogy* or Hegner's *Introduction to Zoölogy*.

The scope of the course should be similar to that outlined in the text-books named. Each student should keep a laboratory note-book in which to enter from day to day a record of the laboratory work done; this record should consist of carefully labeled outline drawings of the chief structures studied, and accurate notes of all observations, experiments or demonstrations which cannot be recorded by drawings. The requirements here outlined are essentially

the same as those specified by the College Entrance Examination Board for the subject of Zoölogy, to which reference should be made for a more detailed description.

LABORATORY NOTE-BOOK.—For one unit credit a candidate must present a properly certified and acceptable laboratory note-book. One-half unit credit may be given (on school record only) for a year's course without submitting a laboratory note-book. All the statements under the head **LABORATORY NOTE-BOOK** on page 42 apply to Zoölogy.

BIOLOGY.

Subject	Units
BIOLOGY	I

A full year of work consisting of both recitations and laboratory practice, as outlined under "Botany" and "Zoölogy," is required. A text, such as Needham's *Biology*, presents good material for such a course.

LABORATORY NOTE-BOOK.—Every candidate must present a properly certified and acceptable laboratory note-book of the character described under Physics on page 42.

PHYSIOLOGY.

Subject	Units
PHYSIOLOGY	$\frac{1}{2}$ or I

For entrance credit in this subject a full year of work as defined under "Zoölogy" will be required for one unit credit. This should include laboratory work and should cover the principles of human and comparative physiology as outlined in Martin's *The Human Body*, briefer course.

LABORATORY NOTE-BOOK.—For full credit a candidate must present a properly certified and acceptable laboratory note-book of the character described under Physics on page 42. One-half unit credit may be given (on school record only) for a year's course without laboratory work or for a half year's course with laboratory work.

PHYSICAL GEOGRAPHY OR PHYSIOGRAPHY.

Subjects	Units
PHYSICAL GEOGRAPHY OR PHYSIOGRAPHY	$\frac{1}{2}$ or I

For one unit credit preparation should extend for five periods per week for one year, following a course as laid down in one of the standard modern text-books that are designed for High Schools. Its scope should be that as indicated in such a text-book. The course should include study of the text-book and individual laboratory work to illustrate the text. At least one-third of the time should be de-

voted to laboratory exercises; the examples to illustrate the text should be drawn as far as possible from local sources, which may be done by including field excursions as a part of the course, or problems involving a study of the local region may be assigned to the student as a part of the laboratory exercise.

The course should aim to give the student a grasp of the general physiographic features of the earth and the dynamic actions going on at the surface, the interaction of the earth, air and water, with their results, and the relation of these to life.

More detailed information may be obtained by reference to the outline of study recommended in the circular of the College Entrance Examination Board.

LABORATORY AND FIELD NOTE-BOOK.—For one unit credit a candidate must present a properly certified and acceptable laboratory note-book. One-half unit credit may be given (on school record only) for a year's course without submitting a laboratory note-book or for a half year's course with an acceptable laboratory note-book. All the statements under the head **LABORATORY NOTE-BOOK** on page 42 apply to Physical Geography.

GEOLOGY.

Subject	Units
GEOLOGY	½ or 1

Full preparation in Geology should include at least five periods per week for one year, following a course as laid down in one of the recent text-books that are designed for secondary schools. The subjects treated should include dynamic and structural geology and historical geology; or, when but half a year is devoted to the subject, the course might be shortened by the omission of the historical geology, which cannot be treated very satisfactorily without a collection of specimens illustrating the geological formations. The course in dynamic and structural geology should be designed to give the student a knowledge of the materials composing the earth, including an acquaintance with the commoner stratified and igneous rocks and their classification; the work of the surface agents (the atmosphere, the action of running water, underground water, snow and ice, the sea), both in the wearing away and the shaping of the surface, and in the building up of deposits; the work of the internal agents, vulcanism, the movement of the crust, both the rapid movements (earthquakes) and the slow, secular movements which permanently deform the rocks. As far as possible the subjects treated should be illustrated by field work, of which notes should be kept. The rocks, considered as materials, should be studied directly from specimens in the laboratory and notes kept

of the observations. The course in historical geology should be designed to give the student a knowledge of the principles upon which geological chronology is based, and of the geological formations as they illustrate the earth's history from its beginnings in the Precambrian up to the present time. The various geological groups and systems should be studied in their chronological order and illustrated by maps and specimens. Where local illustrations are available, the student should be encouraged to make his own observations; and field trips to examine the local formations should be taken, of which notes should be kept.

LABORATORY AND FIELD NOTE-BOOK.—For one unit credit a candidate must present a properly certified and acceptable laboratory note-book. One-half unit credit may be given (on school record only) for a year's course without submitting a laboratory note-book or for a half year's course with an acceptable laboratory note-book. All the statements under the head **LABORATORY NOTE-BOOK** on page 42 apply to Geology.

ASTRONOMY.

Subject	Units
ASTRONOMY	$\frac{1}{2}$ or 1

The Celestial Sphere and its circles, the Solar System, tides, eclipses; the nature, distances and sizes of the stars and nebulae and how these are determined; comets and shooting stars; the spectroscope and the more important astronomical instruments; Newton's Law and Kepler's three laws. A brief general course in the subject, such as is given, for example, in Young's *Lessons in Astronomy* (with Appendix).

ECONOMICS.

Subject	Units
ECONOMICS	$\frac{1}{2}$ or 1

This study should afford an introductory knowledge of modern economic theories and practical problems. Value and price, production, distribution, exchange, problems of trade, currency, labor, industrial organization, and other practical questions should be included in the field of study.

BUSINESS LAW.

Subject	Units
BUSINESS LAW	$\frac{1}{2}$ or 1

This study should cover the elementary principles of law relating to the more common business transactions, with especial reference to the requirements of a binding contract.

COMMERCIAL GEOGRAPHY.

Subject	Units
COMMERCIAL GEOGRAPHY	$\frac{1}{2}$ or 1

Classroom work, conducted under definite instruction, aided by text-book study. The field of study should include a consideration of influences affecting the production, distribution and exchange of commodities, and of products and regions by types.

DRAWING.

Subject	Units
DRAWING	$\frac{1}{2}$ or 1

The candidate's preparation in drawing should be directed toward training him in accurate observation and in definite and truthful representation of form, without attempt to represent color or color values.

The candidate should be able to draw correctly and with lines of good quality simple forms in correct perspective in the size in which it is felt in the plane of the drawing, or larger or smaller. It is recommended that pupils should be taught to draw from the object itself rather than from the flat.

Correctness of proportion and accuracy in the angles and curves and structural relations of the parts of every object drawn are of the highest importance.

The elementary principles of perspective are to be thoroughly learned, and the candidate should be able to apply them in freehand drawing from the object or from the imagination.

No definite prescription as to method of teaching is made. The examination will test the preparation of the candidate in the following points:

1. Ability to sketch from the object with reasonable correctness as to proportion, structure, and form. It is recommended that the subjects drawn include simple geometrical objects and simple natural objects such as living plant forms.
2. Ability to sketch freehand from dictation with reasonable accuracy any simple geometrical figure or combination of figures.
3. Ability to represent accurately in perspective a simple geometrical solid of which projection drawings are given, and ability to make consistent projection drawings of a simple geometrical solid of which a perspective representation is given.
4. Ability to answer questions in regard to the principles involved in making these drawings.

The preparatory work in Mechanical Drawing should include the use of drawing instruments, geometric projection, and the principles of orthographic projection.

MANUAL TRAINING.

Subject	Units
MANUAL TRAINING	½ or 1

Under the head of Manual Training are included the following subjects:

Joinery, sheet metal work, moulding, pattern making, forging and machine work. The student should be familiar with the nature of the usual shop processes and methods of work, and the properties of materials commonly used in construction.

ADMISSION TO ADVANCED STANDING.

(1) A student who presents himself for admission to advanced standing will be examined (a) in the subjects required for admission to the Freshman Class, and (b) in those subjects for which the applicant desires to receive advanced credit.

At its option, the Committee on Admission to Advanced Standing may accept, without examination in the case of a student who comes from another college of recognized standing, the preparatory subjects credited by that college and the work done therein in any subjects which correspond to subjects in the course he wishes to enter, provided a statement is submitted properly certified by the authorities of the college, stating in detail the entrance credits granted and the extent and character of the work done with the grades attained.

(2) Every applicant for admission to advanced standing must present a letter of honorable dismissal from the institution last attended.

(3) A student who has done sufficient work elsewhere to enable him to complete in one year the work required for the Bachelor's degree, in the course which he proposes to enter, may be admitted to the Senior Class, but each student so admitted must take at least twelve units of work at the University of Pennsylvania.

(4) No student may be admitted as a candidate for a degree after the beginning of the Senior year of the class with which he would graduate.

All communications regarding admission to advanced standing should be addressed to the Chairman of the Committee on Admission to Advanced Standing, College Hall, University of Pennsylvania.

ADMISSION TO SPECIAL AND PARTIAL COURSES.

Every applicant for admission as a Special or Partial student is required to fill out and file with the Admission Committee a blank containing such questions as may seem necessary to determine his general educational fitness, the reasonableness of his application, and the propriety of entertaining it. This blank must be accompanied by certificates covering the statements thereupon and must be received in time to have these certificates verified and approved before the beginning of the course for which application is made.

All communications regarding admission to special and partial courses should be addressed to the Chairman of the Committee on Admission to Special and Partial Courses, College Hall, University of Pennsylvania.

SPECIAL COURSE IN ARCHITECTURE.

Candidates for admission to the two-year Special Course in Architecture must be at least twenty-one years of age (unless graduates of public high schools), and must have spent two years at work in the office of a practicing architect; or must have had such other technical training as may, in the judgment of the professor of architecture, be considered as equivalent. A candidate who is not a graduate of a public high school, or an equivalent preparatory school, will be required by the committee to satisfy the professors in charge that he is qualified to take the work.

Candidates must further pass examinations in Freehand and Instrumental Drawing. Those who do not at the time of admission satisfy this requirement, must include equivalent work in their course.

Roster of Examinations for Admission to the Towne Scientific School.

JUNE AND SEPTEMBER, 1915, AND JANUARY, 1916.

English A (Grammar and Composition)			
English B (General and Specific Reading)	Friday	Tuesday	Tuesday
(Both of these subjects may be taken during one 3-hour period)	June 18	Sept. 14	Jan. 18
	2-5	2-5	3.30-6.30
Mathematics A (Algebra, both A ₁ and A ₂)	Monday	Thursday	Monday
	June 21	Sept. 16	Jan. 17
	2-5	2-5	7-10

Mathematics A₁ (Algebra to Quadratics), or Mathematics A₂ (Algebra, Quadratics and Beyond)	Monday June 21 2-4	Thursday Sept. 16 2-4	Monday Jan. 17 7-9
Mathematics B (Higher Algebra)	Tuesday June 22 9-11	Friday Sept. 17 9-11	Tuesday Jan. 25 4.30-6.30
Mathematics C (Plane Geometry)	Saturday June 19 11.15-1.15	Wednesday Sept. 15 11.15-1.15	Friday Jan. 21 4.30-6.30
Mathematics D (Solid Geometry)	Wednesday June 23 9-11	Saturday Sept. 18 9-11	Thursday Jan. 27 4.30-6.30
Mathematics E (Rudiments of Plane Trigonometry)	Monday June 21 11.15-12.45	Thursday Sept. 16 11.15-12.45	Wednesday Jan. 26 7-8.30
Mathematics F (Plane Trigonometry)	Monday June 21 11.15-1.15	Thursday Sept. 16 11.15-1.15	Tuesday Jan. 25 7-9
History A (Ancient) History B (Medieval and Modern) History C (English) History D (American) Civil Government (Any two of these subjects may be taken during the same 3-hour period)	Thursday June 17 2-5	Monday Sept. 13 2-5	Tuesday Jan. 18 7-10
Latin A (Grammar and Elementary Prose Composition) Latin D (Virgil and Sight Translation of Poetry) Latin L (Advanced Prose Composition) (All of these subjects may be taken during the same 3-hour period)	Saturday June 19 2-5	Wednesday Sept. 15 2-5	Wednesday Jan. 19 7-10
Latin B (Cæsar and Elementary Sight Translation of Prose) Latin C (Cicero and Advanced Sight Translation of Prose) (Both of these subjects may be taken during the same 2-hour period)	Monday June 21 9-11	Thursday Sept. 16 9-11	Monday Jan. 24 4.30-6.30
Greek B (Xenophon, Anabasis, Bks. I-IV) Greek C (Homer, Iliad, Bks. I-III) (Both of these subjects may be taken during the same 2-hour period)	Tuesday June 22 9-11	Friday Sept. 17 9-11	Friday Jan. 25 4.30-6.30

Greek F (Prose Composition)			
Greek G (Sight Translation of Prose)	Tuesday June 22	Friday Sept. 17	Friday Jan. 28
(Both of these subjects may be taken during the same 2-hour period)	11.15-1.15	11.15-1.15	4.30-6.30
German A (Elementary German)	Friday June 18 9-11	Tuesday Sept. 14 9-11	Wednesday Jan. 19 4.30-6.30
German B (Intermediate German)	Wednesday June 23 11.15-1.15	Saturday Sept. 18 11.15-1.15	Wednesday Jan. 26 4.30-6.30
German C (Advanced German)	Monday June 21 9-11	Thursday Sept. 16 9-11	Wednesday Jan. 26 4.30-6.30
French A (Elementary French)	Saturday June 19 9-11	Wednesday Sept. 15 9-11	Thursday Jan. 20 4.30-6.30
French B (Intermediate French)	Tuesday June 22 11.15-1.15	Friday Sept. 17 11.15-1.15	Friday Jan. 28 4.30-6.30
French C (Advanced French)	Thursday June 17 11.15-1.15	Monday Sept. 13 11.15-1.15	Friday Jan. 28 4.30-6.30
Spanish A (Elementary Spanish)	Thursday June 17 9-11	Monday Sept. 13 9-11	Wednesday Jan. 26 7-9
Spanish B (Intermediate Spanish)	Wednesday June 23 11.15-1.15	Saturday Sept. 18 11.15-1.15	Wednesday Jan. 26 7-9
Italian A (Elementary Italian)	Thursday June 17 11.15-1.15	Monday Sept. 13 11.15-1.15	Tuesday Jan. 25 7-9
Italian B (Intermediate Italian)	Tuesday June 22 9-11	Friday Sept. 17 9-11	Tuesday Jan. 25 7-9
Physics	Friday June 18 11.15-1.15	Tuesday Sept. 14 11.15-1.15	Thursday Jan. 27 7-9
Chemistry	Tuesday June 22 2-5	Friday Sept. 17 2-5	Thursday Jan. 20 7-10
Botany	Wednesday June 23 2-5	Saturday Sept. 18 2-5	Monday Jan. 24 7-10
Zoölogy	Wednesday June 23 2-5	Saturday Sept. 18 2-5	Friday Jan. 21 7-10
Biology	Wednesday June 23 2-5	Saturday Sept. 18 2-5	Friday Jan. 28 7-10

Physiology	Wednesday June 23 2-5	Saturday Sept. 18 2-5	Friday Jan. 28 7-10
Physical Geography, or Physiography	Thursday June 17 9-11	Monday Sept. 13 9-11	Saturday Jan. 22 4-6
Geology	Tuesday June 22 2-5	Friday Sept. 17 2-5	Saturday Jan. 22 3-6
Astronomy	Tuesday June 22 2-5	Friday Sept. 17 2-5	Saturday Jan. 22 2-5
Economics	Monday June 21 11.15-1.15	Thursday Sept. 16 11.15-1.15	Saturday Jan. 22 2-4
Business Law	Thursday June 17 11.15-1.15	Monday Sept. 13 11.15-1.15	Saturday Jan. 29 2-4
Commercial Geography	Wednesday June 23 9-11	Saturday Sept. 18 9-11	Saturday Jan. 29 2-4
Freehand Drawing	Wednesday June 23 2-5	Saturday Sept. 18 2-5	Saturday Jan. 29 2-5
Mechanical Drawing	Wednesday June 23 2-5	Saturday Sept. 18 2-5	Saturday Jan. 29 2-5
Manual Training	Wednesday June 23 2-5	Saturday Sept. 18 2-5	Saturday Jan. 29 2-5

All candidates are required to register for the examinations they desire to take, and obtain cards to be presented to the examiners.

The registration office is in College Hall and will be open from 8.30 to 5 o'clock on June 17th, and on September 13, 1915, from 9 to 1 o'clock on Saturdays, and from 9 to 5 o'clock on all other days on which examinations are given.

Candidates for English **A** in June or September should present themselves for registration not later than 9 o'clock on the day of registration.

Every candidate must present at the time of registration, either a certificate previously issued by an Admission Committee, or a certificate from the head-master of his school, or from his tutor, naming the subjects in which he is prepared. Blank certificates for the latter purpose may be obtained upon application.

Candidates must be present promptly at the beginning of the period, even if they do not intend to take more than one of the examinations scheduled for the period.

Information will be given at the registration office as to the places of the examinations.

All candidates for admission are required to take the examination in English **A**. Those candidates who have otherwise completely fulfilled the entrance requirements may take the examination in English **A** on Monday, September 27, 1915, from 2 to 4 o'clock. Such candidates should register for that examination on that day from 9 to 12 o'clock.

The examinations may be distributed over several examination periods, provided that no examination can be counted that is taken more than twenty-eight months before the date of matriculation.

Candidates preferring to be examined away from Philadelphia may take the examinations of the College Entrance Examination Board. They will be held on June 14 to 19, 1915. Further information may be obtained by addressing the College Entrance Examination Board, Post Office Sub-station 84, New York, N. Y.

Preparation for the examinations in Chemistry, Botany, Zoölogy, Biology, Physiology, Physical Geography and Geology should include laboratory or field work, and properly certified note-books should be presented at the time of the examinations.

Candidates should call for their note-books at the Admission Office about November 1st, or send postage for their return.

The certificate in the note-book should be to the effect that the note-book presented is a true and original record of experiments actually performed.

No note-book is required for Physics **A** (one-half unit), but if a full unit of credit in Physics is desired, the requirement of a note-book holds as for other sciences.

In determining the mark in subjects in which a note-book is required, the ratio of counts for laboratory note-book and for examination will be as 30 is to 70.

GENERAL INFORMATION.

STATUS AND CLASSIFICATION OF STUDENTS.

REGULAR STUDENT.

A Regular Student is one who has satisfied the Entrance Requirements, and is a candidate for a degree, pursuing his studies in a manner and to the amount prescribed.

SPECIAL STUDENT.

A Special Student is one who is registered, with the approval of the Committee on Special and Partial Students, in a special course prescribed by a Departmental Staff.

PARTIAL STUDENT.

A Partial Student is one who, under certain conditions, approved by the department concerned, and the Committee on Special and Partial Students, is permitted to pursue such individual subjects as he is competent to take.

A Special or Partial Student who may desire to become a Regular Student, must apply to the Committee on Students' Standing.

A unit of work is one hour a week for a year in lecture or recitation, or two hours a week for a year in laboratory, drafting room, field, or shop work.

A student in a course will be advanced to the next higher class if, at the opening of the college year, he has credit in sixty (60) per cent. of the total number of units scheduled in the Catalogue as the work of the preceding class.

A student shall have on his roster a number of hours equivalent to not less than ten (10) units, in addition to the required work in Physical Education.

FEES AND DEPOSITS.

The amounts noted in the appended schedule are for *Regular and Special Students*, and are for the full academic year. Tuition fees are payable *in advance* in two equal parts, on October 1 and February 1, respectively. Remittances should be in cash, or by bank draft, certified cheque or postal money order, drawn for the exact amount due, made payable to the University of Pennsylvania, and sent to William O. Miller, Bursar, Room 102, College Hall. For detailed "Regulations Governing Payments," see Part V of the Catalogue.

Courses	Amount
Architecture	\$200 00
Chemical Engineering	200 00
Chemistry	200 00
*Civil Engineering	200 00
Mechanical or Electrical Engineering	200 00

A matriculation fee of five dollars (\$5.00) is charged for every new student entering the Towne Scientific School.

FEE FOR GYMNASIUM AND HOUSTON CLUB.

A fee of ten dollars (\$10.00) is added to the tuition fee of every student in the Towne Scientific School for the privileges of the Gymnasium and the Houston Club. This fee is payable *in advance* in two equal parts on October 1 and on February 1.

FEES FOR PARTIAL STUDENTS.

The tuition fees of a Partial student in any course of the Towne Scientific School are ten dollars (\$10.00) a term for each hour a week, or, in the case of laboratory or drawing room work, ten dollars (\$10.00) a term for each two hours a week. The maximum fee required of a Partial student shall, however, in no case exceed in amount the regular tuition fees of the department in which the student is registered.

FEE FOR RE-EXAMINATION.

If a second re-examination be taken, a fee of five dollars (\$5.00) will be charged, a receipt for which shall be presented to the Instructor holding the examination.

The student must in each case bring a statement showing that he is entitled to a second re-examination. After this statement has been approved by the Dean the proper charge card will be made out.

DEPOSITS AND EXPENSES.

Each student on entering College is required to make a money deposit to cover loss of books, keys, etc., breakage in the laboratories, damage to University property, and other expenses. Any balance is returned upon graduation or withdrawal from College. The deposit for each course is given in the appended table:

*Students in the Sophomore Class in Civil Engineering will be required to pay a special fee of \$10.00 at the beginning of the second term, in connection with the prescribed four-week course in Surveying at the end of that term. This fee will be refunded to students who withdraw from the Towne Scientific School before the end of the second term.

Architecture	\$10 00
Chemistry	25 00
Engineering, all courses	25 00

GRADUATION AND CERTIFICATE FEES.

A graduation fee of twenty dollars (\$20.00) is charged to each candidate for a baccalaureate degree, and ten dollars (\$10.00) to each candidate for the degree of Master of Science in Architecture. A like fee of ten dollars (\$10.00) is charged to each candidate for the technical degree of Chemical Engineer, Civil Engineer, Electrical Engineer, or Mechanical Engineer. The fee for Certificate of Proficiency in the Two-Year Special Course in Architecture is ten dollars (\$10.00). *No student will be recommended for a degree or certificate until all fees due the University have been paid.*

BOARD AND LODGING.

Accommodation for students is provided in the Dormitories.* Plans, prices, and all other information relating to the Dormitories may be had upon application to the Bursar. In order to make sure of rooms, students are advised to apply as early as April 1, if possible.

Table board may be had in the immediate vicinity of the University at prices ranging from \$3.50 per week upwards. A printed list of approved boarding places, with or without lodging, may be obtained at the Dean's office. The average price paid by students in such quarters for board and lodging is \$5.50 per week.

The figures given herewith are based upon the cost of living, either in the dormitories or in a boarding house:

	Min.	Max.
Board and lodging—thirty-seven weeks	\$185 00	\$350 00
Tuition and other fees	210 00	210 00
Text-books (estimated)	10 00	25 00
Graduation or Certificate Fee	10 00	20 00
	<hr/>	<hr/>
	\$365 00	\$605 00

DIVISION OF SESSIONS.

The college year is divided into two terms of about eighteen weeks each. The first term began in 1914, on September 25,† at 10 o'clock A. M. The second term began on February 8, 1915, at 9 o'clock and will end with Commencement on June 16. The examinations for entrance in 1915 will begin on June 17 and September 13, also January 18, 1916.

*Fuller information in regard to the Dormitories will be found in Part V of the General Catalogue.

†Absences are counted from the beginning of the term.

EXAMINATIONS AND GRADES.

A period of two weeks shall be set for examinations and re-examinations at the end of the first term, and a period of two weeks for examinations at the end of the second term.

In reporting the standing of each student on the completion of each subject the following grades only are employed: **D** (distinguished), **G** (good), **P** (passed), **N** (not passed) student is entitled to a re-examination, **F** (failure) subject must be repeated in class, **I** (incomplete), and **O** (omitted) shall be employed.

THESES.

The theses required of candidates for the technical degrees must be sent to the Dean on or before May 1 in each year.

DEGREES.

The degree of *Bachelor of Science in Architecture*, *Bachelor of Science in Chemistry*, *Bachelor of Science in Chemical Engineering*, *Bachelor of Science in Civil Engineering*, *Bachelor of Science in Electrical Engineering*, or *Bachelor of Science in Mechanical Engineering* is conferred on students who complete the four-year course in one of these subjects.

The degree of *Master of Science in Architecture (M.S. in Arch.)* is conferred upon students who complete satisfactorily the work of the fifth, or graduate, year in the course of Architecture.

The technical degrees of *Chemical Engineer (Ch.E.)*, *Civil Engineer (C.E.)*, *Electrical Engineer (E.E.)* and *Mechanical Engineer (M.E.)* are conferred not less than three years after receipt of the baccalaureate degree, upon graduates of the four-year courses in these subjects who have successfully pursued their professions during such period, and who have also presented acceptable original theses.

CERTIFICATES OF PROFICIENCY.

Certificates of Proficiency are awarded to students who pursue, and complete satisfactorily, the Two-Year Special Course in Architecture.

Students who have pursued Partial courses, and who have completed satisfactorily the individual subjects selected in each case, are entitled to an official *Statement of Study*, signed by the Dean.

SCHOLARSHIPS.

Scholarships open to undergraduates in the Towne Scientific School may be divided into two groups: first, those which may be held only by students from certain localities; and, second, those which are general in their allotment. All candidates for scholar-

ships must present themselves for the usual entrance examinations, excepting those who may be admitted on satisfactory diplomas granted by public high or normal schools.

No award of scholarships will be made until after the entrance examinations in June. Only such persons will be eligible for scholarships as have been admitted without conditions in June preceding the opening of the year for which the scholarships are sought. Holders of scholarships who incur conditions forfeit their scholarships.

All candidates for scholarships in the Towne Scientific School (*except those awarded by the City of Philadelphia and the Philadelphia Board of Public Education*) must transmit their applications and credentials to the *Provost on or before the 15th day of May* preceding the opening of the academic year in which they desire to enter. Scholarship application blanks may be procured from the Chairman of the Scholarship Committee (the Provost).

Special attention is called to the fact that, while possession of a scholarship entitles the holder to free tuition, such holders are bound by all University rules and regulations equally with pay students; and any infraction of these regulations will render a holder liable to the forfeiture of his privileges. A scholarship does not carry with it remission of any fee but that for tuition.

GROUP I.

1. THE PENN SCHOLARSHIPS, two in number, founded in 1816, are filled by the Governor of the State from time to time as vacancies occur. They exist by virtue of a privilege confirmed to the heirs of Thomas Penn, one of the original Proprietaries of the Province of Pennsylvania.

2. THE PHILADELPHIA FREE SCHOLARSHIPS.—Under an agreement with the City of Philadelphia, of date 1882, fifty free scholarships exist in the University for the benefit of graduates from the public schools. Of these, THE BENJAMIN FRANKLIN SCHOLARSHIPS, three in number, were endowed by the late Dr. William Pepper. and THE SAMUEL V. MERRICK SCHOLARSHIP by the late J. Vaughan Merrick. Candidates are examined by the Board of Public Education, and the scholarships, according to the number becoming vacant at the end of each academic year, are awarded to those who reach the highest grade in examination, provided that such grade be at least sixty-five per cent. *All inquiries concerning these Scholarships should be addressed to the Secretary of the Board of Public Education, City Hall.*

Under another agreement with the City of Philadelphia, made in 1910, seventy-five free scholarships have been established in the

University for the benefit of graduates from Philadelphia schools in general. *Inquiries concerning the latter scholarships should be addressed to the Mayor of Philadelphia, City Hall.*

GROUP 2.

1. THE BAIRD SCHOLARSHIP, founded in 1889 by Mrs. Matthew Baird, provides free tuition for one student.
2. THE MUHR SCHOLARSHIPS, founded in 1895 by the late Simon Muhr, provide free tuition for three students.
- 3, 4 and 5. THE JAMES LATTA (founded by William J. Latta, Esq.), ROBERT MORRIS and JOHN LOGAN SCHOLARSHIPS, established in 1900, provide free tuition for three students.
6. THE LOUISE HARRISON SCHOLARSHIP, founded in 1900 by Thomas S. Harrison, Esq., provides free tuition for one student in the Department of Chemistry.
7. THE THOMAS S. STEWART SCHOLARSHIP, founded in 1901 by Mrs. Thomas S. Stewart and the Messrs. Thomas S. and Ralph C. Stewart, provides free tuition for one student in Architecture. In the event of no suitable person presenting himself at any time in Architecture, the scholarship may be awarded in other departments.
8. THE HARTMAN KUHN SCHOLARSHIP, founded in 1901 by C. Hartman Kuhn, Esq., in memory of his grandfather, of the Class of 1800, College.
9. THE THOMAS H. POWERS SCHOLARSHIP, founded in 1901 by Mrs. Mary Powers Harris, in memory of her father.
10. THE CHARLES BRINTON COXE SCHOLARSHIP, founded in 1901 by Eckley Brinton Coxé, Jr., in memory of his father, of the Class of 1862, College.
11. THE E. OTIS KENDALL SCHOLARSHIP, founded in 1901 by the Class of 1879, College, in memory of the late Vice-Provost of the University.
12. THE THOMAS CADWALADER SCHOLARSHIP, founded in 1901 by John Cadwalader, Esq.
13. THE STEPHEN GREENE SCHOLARSHIP, founded in 1901.
14. THE CLASS OF 1878 MEMORIAL SCHOLARSHIP, founded in 1903.
15. THE ARCHITECTURAL ALUMNI SCHOLARSHIP, founded in 1903, provides free tuition for one student in Architecture, the nomination being vested in the Architectural Alumni Society of the University of Pennsylvania.
16. THE GEORGE SCHLEICHER SCHOLARSHIP.—Under the will of the late George Schleicher, of Philadelphia, the German Society of Pennsylvania, of date 1903, holds in trust a fund for maintaining in this University a perpetual scholarship named after the testator. The income from \$5000 is awarded annually to assist any worthy

person of German birth or descent in the pursuit of his studies at Pennsylvania in any branch of learning except religion.

17. THE ALBERT MONROE WILSON SCHOLARSHIP, founded in 1904 by the Alumni of the College, in memory of the late janitor of College Hall, and as a tribute to his zealous fidelity to duty during nearly fifty years of service in the University.

18. THE GEORGE BARNETT SCHOLARSHIP in Mechanical Engineering, founded in 1904 by his daughter, Mrs. Irene Barnett Halstead.

19. THE ECKLEY B. COXE SCHOLARSHIP, founded in 1904 by Mrs. Eckley B. Coxé, in memory of her husband, of the Class of 1858, College.

20. JUSSEY FRENCH TRAVELING SCHOLARSHIP, founded 1912, by Joseph G. Rosengarten, Esq., awarded annually upon the recommendation of the Department of French to that student considered best prepared for study at some one of the French universities.

21. THE MARTHA AUSTIN McDOWELL SCHOLARSHIP, founded in 1905 by her father, J. Austin McDowell, to be awarded without limitation as to department.

23. THE LAVINA BARNETT FAIRCHILD SCHOLARSHIP, founded in 1906 for students in Civil Engineering.

24. THE WILLIAM P. HENSZEY SCHOLARSHIP, founded in 1906 by William P. Henszey of Philadelphia, to be awarded without limitation as to department.

25. THE SAMUEL R. SHIPLEY SCHOLARSHIP, founded in 1907.

28. THE ADAM CLARKE THOMPSON SCHOLARSHIP, founded in 1907, by Mrs. Robert E. Cook and Rev. William J. Thompson, in memory of their brother, of the Class of 1892, College.

30. THE S. W. ROBERTS SCHOLARSHIP, founded April, 1882.—About \$50 toward the tuition of one student.

31. THE JOHN WHITE FIELD SCHOLARSHIP, established January, 1899.—For a student from the Central High School.

32. THE FRANCES PETERS SCHOLARSHIP, established January, 1899.—For a student from the Central High School.

33. THE HOWARD N. POTTS SCHOLARSHIPS, established 1906.—Three free scholarships.

34. THE JOHN CLARKE SIMS MEMORIAL SCHOLARSHIPS, founded in 1909, in memory of the late John C. Sims, a Trustee of the University, and formerly Secretary of the Pennsylvania Railroad. One of the Scholarships is open to persons nominated by the Trustees of the University, and the other is open to employes, and to sons of living or deceased employes of the Pennsylvania Railroad lines, east and west of Pittsburgh, both to be awarded under the rules governing the granting of Scholarships in the University.

35. THE COLEMAN SELLERS SCHOLARSHIP, founded December 7, 1909, by Mrs. S. W. Colton, Jr., in memory of her father, provides for the tuition of a student in the Engineering Department.

36. THE DRIFTON SCHOLARSHIP.—Endowed by Mr. Eckley Brinton Coxe, Jr., May 2, 1910, to be used only for young men from the coal regions of Pennsylvania.

37. THE ROBERT HORNER SCHOLARSHIP, founded in 1910 by Mr. Samuel Horner, Jr., in memory of his son, a member of the Class of 1900, College, open to any department.

38. THE CHARLES E. ELLIS SCHOLARSHIPS, established 1911.—The will of Charles E. Ellis provides that the beneficiaries are to be restricted to students of the public schools of Philadelphia, to be appointed by the Superintendent of the public schools through arrangement with the Commonwealth Trust Company. Two scholarships are to be available annually.

39. THE CAMDEN (N. J.) MANUAL TRAINING HIGH SCHOOL SCHOLARSHIP, established in January, 1910, by the Associate Alumni of that school, is awarded annually to a graduate of the same, subject to all the rules and regulations of the University.

40. WALTER E. HERING SCHOLARSHIPS.—Three scholarships, established 1910, open for five years in any department of the University.

41. THE GEORGE W. FETTER SCHOLARSHIP, established in May, 1910, by Mrs. George W. Fetter, in memory of her husband, subject to all the rules of the University.

44. CLASS OF EIGHTY-SIX COLLEGE MEMORIAL SCHOLARSHIP FUND.—Founded 1912 by the Class of 1886, College, for the tuition of one student.

45. HENRY WILSON SPANGLER MEMORIAL SCHOLARSHIP IN ENGINEERING, founded February, 1914, by the graduates of the Towne Scientific School, provides for the tuition of one student, preference to be given to needy students in the following order: Mechanical, Electrical, Chemical and Civil Engineering; in any allied branch of Engineering, or in Architecture.

PRIZES FOR 1914-15.

FRESHMAN ENTRANCE PRIZES.

1. THE EUGENE DELANO PRIZE of fifty dollars for the best special examination in the French and German required for entrance to College.

The following prizes are offered annually:

NOTE.—*All essays in competition for prizes must be handed to the appropriate Dean on or before May 1 in each year, must be signed with a fictitious name, and be accompanied by a sealed envelope, on which is written the fictitious name, and in which are enclosed the*

writer's real name and address. No prize will be awarded unless the work done for it reaches a high standard of excellence. Unless otherwise stated, the prizes are open to regular students only.

I. PRIZES FOUNDED BY ORGANIZATIONS:

1. THE HENRY REED PRIZE, founded by the SOCIETY OF THE ALUMNI (College), for the best English Essay by a member of the Senior Class, College, Wharton and Towne Scientific Schools, entitles the successful competitor to one year's interest on six hundred dollars. Essays in competition for this prize are handed to the Dean for transmission to a committee of the Board of Trustees, by whom the prize is awarded. Subject: *American Description of England*.

4. A prize founded by the PHI KAPPA SIGMA FRATERNITY in honor of their founder, Samuel Brown Wylie Mitchell, M.D., of the Class of 1852, for the most meritorious work done in the course in English Composition of the second year. It entitles the successful competitor to one year's interest on four hundred dollars.

5. THE ASSAYERS AND MINERS GANGUE offers a prize of the value of twenty-five dollars in books or apparatus to Post-Seniors in Chemistry and to Seniors in Chemistry (four-year course); the prize to be awarded by the Gangue with the advice of the professor in charge.

6. THE PRIESTLEY CLUB, composed of Alumni of the Chemical Department, offers a prize of twenty dollars each year to that member of the Graduating Class (Post-Senior or Senior, four-year course, Regular or Special), whose work for that year is most satisfactory. The award of the prize is to be determined by the Director of the John Harrison Laboratory of Chemistry, based upon the student's application, the grade obtained by examination and the presentation of a satisfactory thesis.

7. THE DANTE SOCIETY offers annually a prize of one hundred dollars for the best essay on a subject drawn from the life and works of Dante. Competition is open to all students, and graduates of not more than three years' standing, of any college or university in the United States. The judges of the essays submitted are a committee of the Society. For further information address the Secretary of the Society, Professor F. N. Robinson, Longfellow Park, Cambridge, Mass.

8. THE PHILADELPHIA GROUP OF THE ALLIANCE FRANCAISE, established in 1904, awards annually a medal to the student of either the Junior or Senior classes who has done the most meritorious work in French over and above the required courses.

9. THE PRIZE IN ARCHITECTURE of the American Academy in Rome, open for competition among qualified undergraduates and graduates of certain American architectural schools, including that

of the University of Pennsylvania. This prize grants three years of residence and travel abroad for the study of classic and Renaissance architecture.

10. FACULTY PRIZE IN ARCHITECTURE.—The staff of instruction in Architecture will provide and award a medal to that student, candidate this year for the degree in architecture, who shall have attained the highest standing throughout his course.

11. THE AMERICAN INSTITUTE OF ARCHITECTURE will award a medal to that student receiving in 1915 the Bachelor of Science degree in Architecture, who shall have had the highest record in his class throughout his class. This medal is likewise offered in each of the Schools of the Association of Collegiate Schools of Architecture.

II. PRIZES FOUNDED BY INDIVIDUALS:

1. A prize founded by HENRY LABARRE JAYNE, ESQ., of the Class of 1879, for the best English Composition by a member of the Freshman Class. It entitles the successful competitor to one year's interest on two hundred dollars. Subject: *The Stories of Sir Arthur T. Quiller-Couch*.

2. A prize, originally founded by the late D. VAN NOSTRAND and generously continued by his business successors, for the member of the Junior Class in Civil Engineering who attains the highest general average of scholarship during the Junior year. The prize consists of twenty-five dollars.

4. THE FRAZIER PRIZE.—GEORGE H. FRAZIER, ESQ., of the Class of 1887, offers annually a prize (founded 1897) of a standard work in literature, to be chosen by him, and of a value of one hundred dollars, to the student in the College, Towne Scientific or Wharton Schools of the University of Pennsylvania, who, being a member of the Football team, Baseball team, Track team, or of the Crew, shall attain the highest standing in scholarship.

5. THE ARTHUR SPAYD BROOKE MEMORIAL PRIZE in the School of Architecture, of a cash value of fifty dollars, is awarded annually, in the form of medals, for meritorious work in Design, as follows: for the best record of distinguished rank, a Gold Medal of about forty dollars in value; for records of second and third place and of superior excellence, a Silver and a Bronze Medal, respectively. This prize has been established by MARIA WHARTON BROOKE, as a memorial to her son, ARTHUR SPAYD BROOKE, a graduate in Architecture of the Class of 1897.

7. THE GEORGE SCHLEICHER PRIZE.—Under the will of the late GEORGE SCHLEICHER, of Philadelphia, the German Society of Pennsylvania holds in trust a fund for maintaining in perpetuity a prize to be named after the testator. This prize is of a value of fifty

dollars, and is awarded annually to the best student—of whatever nationality he may be—in the German Language, or German Literature, or both.

8. THE JOHN STEWARDSON MEMORIAL SCHOLARSHIP IN ARCHITECTURE.—The value of this scholarship (established in 1897) is one thousand dollars, and the holder is required to spend one year in travel and in the study of Architecture in Europe under the direction of the Managing Committee. Candidates must be architectural students or practitioners under thirty years of age, resident in the State of Pennsylvania for at least one year immediately preceding the date of preliminary examinations, which must be passed unless acceptable certificates therefor are presented. The award is made to that candidate successful in the final examination in Design.

9. THE PHILO S. BENNETT PRIZE, given through the generosity of the HONORABLE WILLIAM J. BRYAN. The interest on four hundred dollars is to be awarded annually for the best essay on *The Principles of Free Government*.

11. ORATORY PRIZE FUND.—A prize for the best and a prize for the second best original declamation by a member of the Junior Class; the first prize of \$25, and the second prize of \$15.

13. HUGO OTTO WOLF MEMORIAL PRIZE.—Founded 1912 by the gift of Otto C. Wolf, in memory of his son. To be awarded to any member of the Senior Class in each of the Engineering Courses—Mechanical, Electrical, Civil and Chemical Engineering—who, during the Senior year, by the thoroughness and originality of his work, meets with the greatest approval of the professors in charge.

14. A first prize of \$15 and a second prize of \$10, offered by John Frederick Harbeson, Class of 1910 Architecture, for highest excellence in course in Historic Ornament. First prize to MILES B. DECHANT; second prize to WILLIAM E. KAPP.

SUMMER SCHOOL.

A special circular, containing a full description of the courses to be offered in 1915, may be had upon application to the Director of the Summer School, College Hall, University of Pennsylvania, Philadelphia Pennsylvania.

SUBJECTS OF INSTRUCTION

OFFERED BY THE FACULTY OF

THE TOWNE SCIENTIFIC SCHOOL.

ARCHITECTURE.
ASTRONOMY.
BIBLE, THE.
BUSINESS LAW.
CHEMISTRY.
CIVIL ENGINEERING.
ELECTRICAL ENGINEERING.
ENGLISH.
ETHICS (see PHILOSOPHY).
FRENCH.
GEOLOGY.
GERMANIC LANGUAGES.
HYGIENE.
ITALIAN.
MATHEMATICS.
MECHANICAL ENGINEERING.
METALLURGY.
MINERALOGY.
PHILOSOPHY.
PHYSICAL EDUCATION.
PHYSICS.
SPANISH.

COURSES IN THE TOWNE SCIENTIFIC SCHOOL.

The Faculty of the Towne Scientific School conducts the following courses:

1. *The Courses in Architecture.*
 2. *The Course in Chemical Engineering.*
 3. *The Course in Chemistry.*
 4. *The Course in Civil Engineering.*
 5. *The Course in Electrical Engineering.*
 6. *The Course in Mechanical Engineering.*
-

1. (a) *The Full Course in Architecture* leads to the degree of *Bachelor of Science in Architecture* and requires normally four years for completion.
- (b) *The Graduate Course in Architecture* leads to the degree of *Master of Science in Architecture* and requires normally one additional year for completion.
- (c) *The Two-year Special Course in Architecture* leads, on completion, to a certificate of proficiency in Architecture.
- (d) *The Course in Architectural Engineering* leads to the degree of *Bachelor of Science in Architecture* and requires normally four years for completion.

2. *The Course in Chemical Engineering* leads to the degree of *Bachelor of Science in Chemical Engineering* and requires four years for completion.

3. *The Course in Chemistry* leads to the degree of *Bachelor of Science in Chemistry* and requires four years for completion.

4. *The Course in Civil Engineering* leads to the degree of *Bachelor of Science in Civil Engineering* and requires four years for completion.

5. *The Course in Electrical Engineering* leads to the degree of *Bachelor of Science in Electrical Engineering* and requires four years for completion.

6. *The Course in Mechanical Engineering* leads to the degree of *Bachelor of Science in Mechanical Engineering* and requires four years for completion.

THE COMBINED COURSES IN THE COLLEGE AND THE
TOWNE SCIENTIFIC SCHOOL.

These Combined Courses are designed to meet the needs of such students as may desire to acquire a broad and general foundation prior to taking up their work leading to the degree in the particular course they have selected in the Towne Scientific School. The Combined Courses normally extend throughout a period of six years.

The first two years of work in the College are designed to give the students greater maturity of thought and breadth of view, thus better fitting them in every way for the more specialized work to follow.

A student with the required preparation may in four years complete all of the requirements for the Bachelor's degree in the College and at the same time all of the required work of the first two years in any of the regular courses in the Towne Scientific School.

Such a student is then admitted to the Junior Class in the Towne Scientific School, thereby enabling him to complete his course in the latter in two additional years.

Exceptional students entering the College with advanced credit may possibly be able to complete the Combined Courses in less than six years.

A student entering with the intention of taking one of these Combined Courses must so specify to the Dean of the College in order that he may be assigned to a special adviser.

Such a student shall normally register for the first four years in the College.

For further information consult the Dean of the Towne Scientific School.

THE TOWNE SCIENTIFIC SCHOOL.

A regular scientific course leading to a degree has existed in the College since the year 1852. In 1872 this course was enlarged and organized as a Department of Science, which, in 1875, was in large part endowed under the provisions of the will of the late JOHN HENRY TOWNE, a trustee of the University. In honor of his memory the Department of Science was named *The Towne Scientific School*, which now comprehends the courses in Architecture, in Chemistry, in Chemical Engineering, in Civil Engineering, in Electrical Engineering, and in Mechanical Engineering.

NEW ENGINEERING BUILDING.

The departments of Civil, Electrical, Mechanical and Chemical Engineering of the Towne Scientific School occupy a separate building. It is 300 feet long and 160 feet deep, with a wing 50 feet wide and 40 feet deep at one end, the total working floor space being approximately 128,000 square feet. The construction is fire proof throughout.

The building contains the necessary accommodations for serving as headquarters for all the students in engineering, and a sufficient number of class rooms and drawing rooms for handling all the technical subjects of the departments. In addition it contains extensive laboratories fully equipped with the best modern apparatus for experimental work, pertaining to Civil, Electrical and Mechanical Engineering, including the testing of steam and gas engines, boilers, electric and hydraulic motors, dynamos, transformers and electrical apparatus, pumps and fans, refrigerating machinery, the investigation of the physical properties of the materials of engineering, the study of the laws governing the flow and discharge of water through orifices, weirs and pipes, and facilities for calorimetric and geodetic work. The shops are fully equipped for practical instruction in wood and iron working, forge and foundry work.

THE COURSES IN ARCHITECTURE.

OFFICERS.

EDGAR F. SMITH, PH.D., SC.D., L.H.D., LL.D., PROVOST.

JOSIAH H. PENNIMAN, PH.D., LL.D., VICE-PROVOST.

JOHN FRAZER, A.M., PH.D., DEAN OF THE TOWNE SCIENTIFIC SCHOOL.

WARREN POWERS LAIRD, SC.D., *Architecture: Professor in Charge.*

PAUL PHILIPPE CRET, A.D.G.F. (*Atelier Pascal*), O.L.A., SC.D., *Professor of Design.*

HERBERT EDWARD EVERET^t, *Professor of Drawing and History of Fine Arts.*

GÉORGE WALTER DAWSON, *Professor of Drawing.*

THOMAS NOLAN, PH.B., M.S., A.M., *Professor of Architectural Construction.*

PAUL A. DAVIS, 3D, A.D.G.F. (*Atelier Pascal*), *Acting Professor of Design.*

EDGAR V. SEELER, *Ecole des Beaux Arts (Atelier Laloux)*, *Acting Professor of Design.*

JOHN V. VAN PELT, A.D.G.F. (*Atelier Thierry Deglane*), *Acting Professor of Design.*

ALFRED H. GUMAER, B.S. in Arch., *Assistant Professor of Architectural History.*

PHILIP RICHARDSON WHITNEY, S.B. in Arch., *Assistant Professor of Graphics.*

LEON ARNAL, A.D.G.F., *Assistant Professor of Design.*

GEORGE HOWARD BICKLEY, B.S. in Arch., A.D.G.F., (*Atelier Redon*), *Assistant Professor of Design.*

ROBERT RODES MCGOODWIN, B.S. and M.S. in Arch., *Instructor in Design.*

HERBERT AINSWORTH BLOGG, SP. CERT., *Assistant in Architecture.*

HARRY EWING PARKER, B.S. and M.S. in Arch., *Instructor in Architectural Construction.*

W. POWELL ROBINS, A.D.G.F. (*Atelier Daumet and Esquié*), *Instructor in Design.*

LEICESTER B. HOLLAND, B.S. in Arch., *Instructor in Design.*

THORNTON OAKLEY, B.S. and M.S. in Arch., *Assistant in Free-hand Drawing.*

W. POPE BARNEY, B.S. and M.S. in Arch., *Assistant in Design.*

JOHN F. HARBESON, B.S. and M.S. in Arch., *Assistant in Design.*

JAMES H. CHILLMAN, B.S. and M.S. in Arch., *Assistant in Free-hand Drawing.*

EDUARD G. CONRAD, *Assistant in Freehand Drawing.*

WILMER B. RABENOLD, B.S. in Arch., *Assistant in Freehand Drawing.*

VAN HORN D. WOLFE, A.B., *Assistant in Architectural Construction.*

HERBERT F. EVERETT, *Assistant in Architecture.*

RAYMOND J. RICHARDSON, B.S. in Arch., *Assistant in Architecture.*

FRANCIS ROGER BACON, B.S. in Arch., M.A., *Instructor in Architecture.*

GEORGE W. BAUMEISTER, *Reader in Architecture.*

EDMUND B. TAZEWEILL, *Reader in Architecture.*

English, Modern Languages, Mathematics and Chemistry are given in the School of Arts; Hygiene, in the Department of Hygiene and Testing of Materials in the Department of Civil Engineering.

SPECIAL LECTURES OF 1913-14.

Design, History, etc.

CAROL ARONOVICI, PH.D.

ALFRED H. GUMAER, B.S. in Arch.

J. H. DULLES ALLEN.

LEICESTER B. HOLLAND, B.S. in Arch.

WILLIAM N. BATES, A.M., PH.D.

WARREN P. LAIRD, Sc.D.

ANDREW W. CRAWFORD.

WALTON B. MCDANIEL, A.M., PH.D.

FRANK MILES DAY, B.S.

R. TAIT MCKENZIE, A.B., M.D.

GEORGE B. GORDON, Sc.D.

JOHN V. VAN PELT, A.D.G.F.

ALFRED HOYT GRANGER.

WILLIAM WILLET.

Construction, Practice, etc.

AMOS PEASLEE BROWN, E.M., PH.D.

HENRY A. GARDNER.

FREDERICK EHRENFELD, PH.D.

EMILE G. PERROT.

SPEAKERS IN THE SPECIAL LECTURE COURSE FOR 1914-15.

LEICESTER B. HOLLAND, B.S. in Arch.

CAROL ARONOVICI, PH.D., *General Secretary, Suburban Improvement League, Philadelphia.*

WILLIAM FRANKLIN PARIS, ESQ., *Member, Architectural League of New York; Member, Metropolitan Museum of Art in New York City.*

GEORGE BURNAP, B.S., M.A., *Landscape Architect of Public Buildings and Grounds, Washington, D. C.*

SPEAKERS ON PROFESSIONAL PRACTICE OF 1913-14.

(One hour each.)

FRANK MILES DAY, B.S., F.A.I.A.

JOHN H. RANKIN, F.A.I.A.

MILTON B. MEDARY, JR., F.A.I.A.

HORACE W. SELLERS, F.A.I.A.

THE FULL COURSE IN ARCHITECTURE.

The University offers a full professional course of instruction, leading to the degree of Bachelor of Science in Architecture. While no period is fixed for the completion of its work, the average student can, with diligence, accomplish this in four years.

GRADUATE COURSE.

A Graduate year of instruction is offered, with wide range of selection among subjects for specialization, the degree of Master of Science in Architecture being granted upon its completion. This course is described on pages 83, 84 and 85.

SPECIAL COURSE.

There is offered also a special course of study, open to qualified architectural draughtsmen and comprising the technical subjects most needed by them. This may be completed in two years and leads to a professional certificate in architecture.

COMBINED COURSE IN ARTS AND SCIENCE AND IN ARCHITECTURE.

A candidate for the A.B. or B.S. degree may secure also the Bachelor's Degree in Architecture in six years of work. For the details of this arrangement, address or consult Professor Laird.

SUMMER SCHOOL INSTRUCTION.

(See page 100.)

ENTRANCE REQUIREMENTS.

Requirements for admission to all courses in architecture are given under "General Information," page 28.

OUTLINE OF INSTRUCTION.

THE FULL COURSE.

The University aims to secure to its graduates in Architecture the general training prerequisite to the demands of the best professional practice. To that end the scheme of study combines complete technical instruction with the essentials of a liberal education. The purely professional work is so arranged as to lay a broad and solid foundation for the future needs of the practicing architect, while incidentally preparing the student to become, upon graduation, of immediate usefulness as an architect's assistant. The liberal elements of the course include both those studies essential to a general college education, and those forming that part of the professional curriculum in which special stress is laid on the esthetic side of architecture.

The course of study is organized upon the principle that architecture is primarily a fine art. The study of design is therefore emphasized, the student being required to give to it and to its preparatory and accessory subjects an important portion of his time throughout the course. Supporting this line of study and broadening the general view of the student are the history courses, covering exhaustively the field of architecture and giving general treatment to that of painting and sculpture. Thorough courses are given in the theory and practice of building construction, of building sanitation and on the nature and use of building materials. Draughtsmanship receives constant attention throughout the course, not only in the courses in design and graphics, but also in various lines of instruction in pure drawing.

The professional work thus outlined covers some three-fourths of the student's time. The remainder is devoted to general studies, which are pursued during the first two years of the course, and which include two years each of English (composition, rhetoric and literature); of French or German; and of Mathematics (Trigonometry, Analytic Geometry and Calculus); and one year of Chemistry. The instruction in these subjects is that given also in the course in Arts and Science.

The School of Architecture has a large equipment, comprising a working library of over one thousand volumes; a file of leading American and foreign periodicals; over twenty thousand mounted photographs, plates, illustrations, and lantern slides, classified for ready reference; numerous autograph drawings and models; and a collection of casts from the antique, architectural ornament, etc. The school occupies thirteen rooms in College Hall, and also, as a studio, a large one-story building on the University campus.

THE COURSE IN ARCHITECTURAL ENGINEERING.

This subject is so presented in the School of Architecture that it constitutes a complete course of study leading as distinctly toward special preparation in this field as does the general course toward that in general architectural practice. The fundamental work in each course is the same and specialization takes place in advanced subjects. To this end, the course is so organized that it assures the student both phases of those subjects essential in architectural engineering, namely, a special knowledge of its principles and their application combined with the general grounding in architecture demanded in the equipment of every practitioner, whatever his special line of activity.

The course, briefly outlined, comprises the following essentials: (1) The fundamentals of a general education; (2) Acquaintance

with the underlying theory and the history of architecture; (3) Technical training in drawing and design; (4) Knowledge of the theory and practice of building construction, and, finally and chiefly, (5) Such advanced work in the latter as will prepare the student for work in the special field of architectural engineering.

The completion of this course is rewarded by the degree granted in the general course, that of Bachelor of Science in Architecture.

THE TWO-YEAR SPECIAL COURSE.

Architectural draughtsmen of experience, desiring to supply deficiencies in technical training and unable to give the time necessary to the completion of the full or regular course, are admitted as special students, if eligible under certain requirements indicated on page 54. Such students pursue a definite course of study, arranged to permit the completion, in two years, of much of the advanced technical work of the four-year course; and they may, when prepared, specialize in the subjects peculiar to the course in Architectural Engineering. Also, when prepared at entrance with any of the subjects of the course, they may at once take advanced work in such subjects, thus comprising within the time limit of their course subjects otherwise lying beyond it. A satisfactory completion of this course is recognized by the award of a professional certificate.

ADVANCED STANDING.

Credit is given in any subject of study for fully equivalent work done elsewhere. This permits advanced standing, in the full course, for both "academic" and "technical" subjects, and, in the Special Course, for the latter.

The work of the course in design and in drawing is so arranged that each student, upon admission, is placed in the grade for which he is fitted and may then progress as rapidly as his ability will warrant. To secure standing in any grade beyond the first, the student must present satisfactory evidence of his previous work or undergo a test, or both, as the instructor may require.

TUITION.

Tuition fees for the courses in Architecture are two hundred dollars (\$200.00) per annum.

FELLOWSHIPS, SCHOLARSHIPS AND PRIZES.

The following rewards are open to students in the School of Architecture or to its graduates:

Open to general competition in the United States:

THE PRIZE OF THE AMERICAN ACADEMY IN ROME (page 62).
(Awarded to University of Pennsylvania graduates 1911 and 1914.)

THE PARIS PRIZE OF THE SOCIETY OF BEAUX ARTS ARCHITECTS
(Awarded to University of Pennsylvania graduates 1911-12-13-14.) Not offered this year.

THE MEDAL OF THE AMERICAN INSTITUTE OF ARCHITECTS
(page 63).

Open throughout the State of Pennsylvania:

THE JOHN STEWARDSON MEMORIAL SCHOLARSHIP (page 64).
(Awarded to University of Pennsylvania students or graduates thirteen times in seventeen awards since foundation.

Open only to University of Pennsylvania students:

THE ARTHUR SPAYD BROOKE MEMORIAL PRIZE (page 63).

THE THOMAS S. STEWART SCHOLARSHIP (page 59).

THE ARCHITECTURAL ALUMNI SOCIETY SCHOLARSHIP (page 59).

THE FACULTY PRIZE (page 63).

THE HARBESON PRIZE (page 64).

OUTLINE OF THE FULL COURSE.

For the Normal Schedule of this course see page 80.

I. ARCHITECTURAL SUBJECTS.

PRACTICE, ETHICS AND THEORY OF DESIGN.

Title of Subject	Hours per week	Unit Value of Sub- ject*	Subject Num- ber	For de- scription see page
Professional Practice	I	I	47	II0
Special Lectures	I	I	48	II0
Composition and Theory of Design.	I	I	49	III

*A unit of work consists of one lecture or recitation, with preparation, each week for one year, or its equivalent in actual time in drafting room, studio or laboratory, about $2\frac{1}{4}$ hours.

DESIGN.

Design, Grade I*.....	8	I	I	IO7
“ “ II.....	18	4†	2	IO7
“ “ III.....	18	4†	3	IO7
“ “ IV.....	24	5	4	IO7
“ “ V.....	24	5	5	IO7
“ “ VI.....	32	14	6	IO7
Elements of Architecture*.....	8	{ $I\frac{1}{2}$ $\frac{1}{2}$	9 10	IO7 IO7

*Part of year.

†Four units for Regulars; five units for Specials.

Note.—Any student who completes Grade II of design before his class finishes 28 may enter Grade III, if in Grade II he has shown a satisfactory working knowledge of 28. This applies also to the entering of Grade IV with respect to 29.

HISTORY.

Title of Subject	Hours per week	Unit Value of Subject	Subject Number	For description see page
Ancient and Medieval	4*	3	43	110
Renaissance and Modern	3†	1½	44	110
History of Painting	1	1	45	110
“ “ Sculpture	1	1	46	110

*2 hours lecture, 2 hours research.

†2 hours lecture, 1 hour research, 1st term only.

DRAWING.

<i>Architectural Drawing</i>	12	1	26	108
(a) Instrumental				
(b) Pencil				
(c) Brush				
(d) Lettering				
<i>Graphics—</i>				
Descriptive Geometry*	6	2	27	108
Shades and Shadows*	6	1	28	108
Perspective	6	1	29	109
<i>Freehand Drawing†—</i>				
Pure Freehand; six grades, viz.:				
I. Form and Proportion	4	1	11	108
II. Light and Shade (charcoal)	4	1	12	108
III. Cast; Arch't'l Ornament ...	4	1	13	108
IV. Cast; Figure Details	4	1	14	108
V. Antique	4	1	15	108
VI. Life	4	2	16	108
Drawing and Design:				
I. Historic Ornament	4	1	20	108
Water Color; four grades, viz.:				
I. Still Life, Monochrome	3	1	21	108
II. Still Life, Color	3	1	22	108
III. Rendering of Arch't'l object.	3	1	23	108
IV. Rendering of Photo. subject.	3	1	24	108

Note.—The student must continue pure freehand drawing until his completion of design. If Grade VI of the former is finished before the latter, drawing from the life will thereupon become an essential part of the work in design.

*Part of each term.

†Grade VI (Life) occupies a full year, the remaining subjects, normally, one-half year each.

ARCHITECTURAL CONSTRUCTION.

Title of Subject	Hours per week	Unit Value of Subject	Subject Number	For description see page
Arch. { Mechanics of Architecture..	5†	2	30	109
Const'n { Carpentry*.....	3	2	32	109
{ Masonry and Ironwork* ..	3	2	33	109
Graphic Statics in Architecture	7†	2	31	109
Sanita- { Hygiene	1§	} 1 {	1	127
tion of { Heat. and Vent.	1§		34	109
Buildings { Plumb. and Drain.....	1§		35	109

* Given in alternative years; 1 hour lectures and quizzes, 2 hours research and drawing; 33 in 1914-15, 32 in 1915-16.

† First term; 3 hours lecture, 2 hours research.

‡ First term for second-year special students and second term for juniors; 3 hours lecture, 4 hours research and drawing.

§ Ten lectures each.

ARCHITECTURAL ENGINEERING.

This constitutes an option in the fourth year in which the following may be substituted for all the subjects of the regular course, except for courses 47, 48 and Phys. Ed. 4.

Title of Subject	Hours per week	Unit Value of Subject	Subject Number	For description see page
Architectural Construction: Design; Grade B	26	6	37	109
Architectural Construction: Design; Grade A	26	6	38	110
Architectural Construction: Theory	6*	4	39	110
Foundations of Buildings	3†	1	40	110
Specifications, Estimates and Contracts	3‡	1	41	110
Materials of Construction	2§	1	C.E. 35	117
Testing Laboratory (Iron, Steel, etc.)	3	1	C.E. 36	117
Testing Laboratory (Cements) ..	2¶	1	C.E. 37	117

* 1 hour lecture, 5 hours drawing.

† 1 hour lecture, 2 hours drawing, 1st term.

‡ 1 hour lecture, 2 hours research and writing, 2nd term.

§ 2nd term.

|| Either term.

¶ 1st term.

II. NON-ARCHITECTURAL SUBJECTS.

FIRST YEAR.

Title of Subject	Lect. or Rec. per week		Unit Value of Sub- ject	Subject Num- ber	For de- scription see page
	1st Term	2d Term			
<i>English—</i>					
Composition	2	2	2	1	122
Language	—	2	1	30	123
Literature	2	—	1	40	123
<i>*French—</i>					
Elementary (elective)	4	4	4	1	124
Reading	2	2	2	2	124
Composition	1	1	1	3	124
<i>Or *German—</i>					
Elementary (elective)	4	4	4	1	126
Reading	2	2	2	2	126
Composition	1	1	1	3	126
<i>Mathematics—</i>					
Trigonometry	4	—	2	33	127
Analytical Geometry	—	4	2	34	127
<i>Chemistry—</i>					
General Inorganic	2 (Lab.2)	2 (Lab.2)	3	1	112
†Physical Education	2	2	1	1	133

SECOND YEAR.

<i>English—</i>					
Composition	1	1	1	3	122
Literature	2	—	1	42	123
<i>*French—</i>					
Reading	2	2	2	4	124
Composition	1	1	1	5	124
<i>Or *German—</i>					
Dramas	2	—	1	5	126
Prose	—	2	1	6	126
Composition	1	1	1	7	126
<i>Mathematics—</i>					
Calculus	2	—	1	37	127
“ Integral	—	2	1	38	127
†Physical Education	2	2	1	2	133

*One only of these languages is required, it being strongly recommended that French be taken. When German is presented for admission, Elementary French may be taken in the first year of the course, followed by French 2 and 3, and French 4 and 5, in the second and third years respectively.

†Physical education is a required course and must be taken during 2 hours each week for the four years spent in the course. This allows 1 unit credit for each year in this subject.

OUTLINE OF THE SPECIAL COURSE.*

Leading to the Certificate of Proficiency in Architecture.

This course comprises technical subjects of full course as follows:

Drawing—28, 29, 13, 14, 15, 20, 21, 22 and 23.

History and Practice—43, 44, 46, 47 and 48.

Architectural Construction—31, 34, 35, 36, and Hygiene 1.

Design—2, 3, 4, 5, 9, 10 and 49.

Physical Education—1 and 2.

For description of these subjects and their unit values see pages 102 to 112 inclusive, and for the normal schedule of the course see page 82.

*Special students who have presented entrance Mathematics (A, C, D and E) may attend classes in Mechanics of Architectural Construction (30) as auditors, while those who have had the mathematics of the full course may elect and receive credit for this subject. Physical Education is a required course and must be taken for 2 hours each week for the two years spent in the course. This allows one unit credit for each year in this subject. Special students who at entrance are deficient in elementary freehand or in instrumental drawing will take these subjects in course.

NORMAL SCHEDULES.

The studies enumerated below constitute the full course. They are presented in such sequence that the average student can complete them in four years by taking in each academic session 24 units of work. The following schedule indicates the student's normal progress, but the subjects are so presented as to allow for advanced standing and for a progress in design and drawing according to individual ability.

SCHEDULE OF THE REGULAR FOUR-YEAR COURSE.

Leading to the Degree of B.S. in Architecture.

FIRST YEAR.

SECOND YEAR.

Subject No.	Units		Subject No.	Units	
	1st Term	2d Term		1st Term	2d Term
Arch. 26; Arch. Drawing	1	—	Arch. 2; Design Gr. II	2	2
" 11; Freeh'd "	1	—	" 3; " " III	—	4
" 12; " "	—	1	" 13; Freeh'd Draw.	1	—
" 9; El. of Arch....	1½	—	" 14; Freeh'd Draw.	—	1
" 10; " " "	—	½	" 43; Arch. History	1.5	1.5
" 1; Elem. Design.	—	1	" 29; Perspective...	1	—
" 27; Desc. Geom....	1	1	" 32; Carp. Const'n	1	1
" 28; Shades and Shadows.	0.5	0.5	Architectural Units..	16	
Architectural Units..	9		Eng. 3; Composition ..	0.5	0.5
Eng. 1; Composition ..	1	1	" 42; Literature	1	—
" 40; Language	1	—	Fr. 4†; Reading.....	1	1
" 30; Literature	—	1	" 5†; Composition...	0.5	0.5
Fr. 2†; Reading.....	1	1	Math. 37; Calculus.....	1	—
" 3†; Composition...	0.5	0.5	" 38; "	—	1
Math. 33; Trigonometry	2	—	Physical Education 2..	0.5	0.5
" 34; Anal. Geom..	—	2			
Chem. 1; G'l Inorganic	1.5	1.5			
Physical Education 1..	0.5	0.5			
Non-Architectural Units	15		Non-Architectural Units	8	
First Year Units	24		Second Year Units ...	24	

† Or German 2, 1 unit each term and 3, ½ unit each term. (Reading and Composition respectively.)

‡ Or German 5, 1 unit first term, 6, 1 unit 2nd term, and 7, ½ unit each term. (Dramas and Prose Reading, and Composition respectively.)

§ Part of each term.

THIRD YEAR.

FOURTH YEAR.

Subject No.	Units		Subject No.	Units	
	1st Term	2d Term		1st Term	2d Term
Arch. 21; Wat. Col. Dr...	1	—	Arch. 6; Design Gr. VI	7	7
" 44*; Arch. History.	2	—	" 16; F. H. Life ...	1	1
" 4; Design Gr. IV	4	1	" 23; Water Color		
" 5; " " V	—	5	Rend.	1	—
" 20; Hist. Ornam't	—	1	" 24; Water Color		
" 15; Freeh'd Draw.	—	1	Rend.	—	1
" 22; Wat. Col. Dr.	1	—	" 45; Hist. of Paint.	0.5	0.5
" 30; Mech. of Arch.	2	—	" 46; Hist. of Sc'lpt.	0.5	0.5
" 31; Graphic Statics	—	2	" 47; Prof. Practice.	0.5	0.5
" 33; M. & I. Const.	1	1	" 48; Special Lect...	0.5	0.5
Hyg. 1; Hygiene			" 49; Theory of Des.	0.5	0.5
Arch. 34; Heat.&Vent. }	0.5	0.5	Physical Education 4..	0.5	0.5
" 35; Pl. & Drain. }					
Physical Education 3..	0.5	0.5			
Total	24		Total	24	

* May extend over one term.

SCHEDULE OF THE FOUR-YEAR COURSE IN ARCHITECTURAL ENGINEERING.

Leading, as in the regular course, to the degree of B.S. in Arch.

The work of the first three years is identical with that of the regular course, and the student is thus not obliged to choose his specialization until the end of his third year. The fourth year is composed of work in advanced architectural construction and of two subjects common to both courses (47 and 48), as follows:

FOURTH YEAR.

Subject and Number of Course	Unit Values	
	1st Term	2d Term
Arch. 37*; Architectural Construction: Design—Grade B	6	—
" 38; " " " Design—Grade A	—	6
" 39; " " " Theory	2	2
" 40; Foundations of Buildings	1	—
" 41; Specifications, Estimates and Contracts	—	1
" 47; Professional Practice	0.5	0.5
" 48; Special Lectures	0.5	0.5
C. E. 35; Materials of Construction	—	1
" 37; Testing Laboratory (Cement)	1	—
" 36†; " " (Iron, Steel, etc.)	1	—
Phys. Ed. 4. Gymnasium	0.5	0.5
Total	24	

*May extend over more than one term.

†Either term.

SCHEDULE OF THE TWO-YEAR SPECIAL COURSE.
Leading to the Certificate of Proficiency in Architecture.

FIRST YEAR.

SECOND YEAR.

Subject No.	Units	Subject No.	Units
Arch. 9; El. of Arch.	1½	Arch. 4; Design, Gr. IV	5
" 10; "	½	" 5; " " V	6
" 28; Shades and Shadows.	1	" 49; Theory of Design ...	1
" 29; Perspective	1	" 15; F. H. Draw., Antique	1
" 2; Design Gr. II	5	" 20; Hist. Ornament	1
" 3; " III	5	" 23; Wat. Col. Rend.	1
" 13; Freehand Drawing ..	1	" 31; Graphic Statics	2
" 14; "	1	Hyg. 1; Hygiene	
" 21; Wat. Col. Drawing...	1	Arch. 34; Heat and Vent. }	1
" 22; "	1	" 35; Pl. and Drain. }	
" 43; Arch. Hist. (Anc. and		" 44; Arch. Hist. (Ren. &	
Med.)	3	Mod.)	2
" 36; Strength of Materials..	2	" 46; Hist. of Sculpt.	1
Phys. Ed. 1. Gymnasium	1	" 47; Professional Practice	1
		" 48; Special Lectures	1
		Phys. Ed. 2. Gymnasium	1
First Year Units	24	Second Year Units	24

SUMMARY OF WORK.

The several courses of study require the completion of units of work as follows:

	Full Course	Special Course
Architectural subjects:		
Drawing (including Graphics)	17	9
History, Practice, Ethics, etc.	10	8
Construction	9	7
Design	36	22
Non-Architectural subjects	24	2
	—	—
Total units required	96	48

COMBINED COURSE IN ARTS AND ARCHITECTURE.

Any ten units in the following subjects may be offered toward both courses, viz.: Arch. 1, 2, 9, 10, 11, 12, 13, 21, 26, 27, 28, 29.

GRADUATE WORK IN ARCHITECTURE.

Advanced instruction in Architecture is offered in a graduate course which, allowing wide latitude of choice among subjects of major interest, leads to the Master's degree. Its work may be completed in a single year or distributed over a longer period. While arranged primarily for the holder of a Bachelor's degree in Architecture equivalent to that of the University of Pennsylvania, other persons, where qualified, may be admitted to its subjects of study. Courses of study are arranged in consultation with the Professor of Architecture.

The candidate for a Master's degree must complete a minimum of twelve units. A unit is equivalent to one "standard course" in the Graduate School of the University; viz., a lecture course of one hour a week for one academic year. The time required for design and drawing courses varies from four hours, upward, per week, for each unit, as determined by the Professor in Charge. As in the Graduate School, the completion of this minimum requirement of twelve courses confers no right upon the student to be recommended for the degree. This action will follow only on a favorable consideration of his achievement by the Faculty in Architecture.

The following groups are offered:

I. ARCHITECTURAL DESIGN:

Major subject comprises the following:

Design (Numbered "Arch. Grad. 1") 34 hours; 8 units.

Drawing from Life (Arch. Grad. 31) 4 hours; 1 unit.

Water Color Rendering (Arch. Grad. 32) .. 3 hours; 1 unit.

Minor subjects. One of the following is required:

History of Architecture (Arch. Grad. 21) .. 2 hours; 2 units.

History of Fine Arts (Arch. Grad. 22) 2 hours; 2 units.

Construction (Arch. Grad. 12) 2 hours; 2 units.

For students wishing both a History and a Construction course a special schedule of four hours work can be arranged.

II. ARCHITECTURAL HISTORY AND CRITICISM: In-

tended for those who desire preparation for research, teaching or criticism in the field of Architecture. The major work of the course will consist of graduate study in the history of architecture, painting and sculpture, supplemented by work in the philosophy of architecture; in ancient languages and history; and in drawing from the life and painting in water color, a total of twelve units of work.

III. ARCHITECTURAL CONSTRUCTION: For students who have not taken the Option in Construction of the Four-Year Course.

Major subject: Construction (including Arch. 37

to 41 inclusive) 42 hours; 10 units.

Minor subject: Materials of Construction—Testing Laboratory (C. E. Nos. 35 to 37 inclusive)

2 hours; 2 units.

IV. ARCHITECTURAL CONSTRUCTION: For students who have taken the Option in Construction.

Major subject: Construction (Arch. Grad. 11) .. 42 hours; 10 units.

Minor subjects:

Design (Arch. Grad. 2) 10 hours; 2 units.

or History (Arch. Grad. 21 or 22) ..,..... 2 hours; 2 units.

THE COURSE IN CHEMISTRY.

OFFICERS.

EDGAR F. SMITH, PH.D., Sc.D., L.H.D., LL.D., PROVOST: *Chemistry; and Director of the JOHN HARRISON Laboratory of Chemistry.*

JOSIAH H. PENNIMAN, PH.D., LL.D., VICE-PROVOST.

JOHN FRAZER, A.M., PH.D., DEAN OF THE TOWNE SCIENTIFIC SCHOOL.

OWEN L. SHINN, PH.D.,

WALTER T. TAGGART, PH. D.,

THOMAS P. MCCUTCHEON, JR., PH.D.,

JOHN FRAZER, A.M., PH.D.,

HIRAM S. LUKENS, PH.D.,

DANIEL L. WALLACE,

GEORGE W. PLUMMER, PH.D.,

THOMAS R. ALEXANDER, JR., A.M.,

J. RAYMOND FITZPATRICK, A.M.,

JOHN H. MÜLLER, PH.D.,

ORLAND R. SWEENEY, A.M.,

WILLIAM B. LEIGHNINGER, A.M.,

HERBERT S. HARNED, PH.D.,

ELVAH H. GRAFTON, M.S.,

OTHO L. THOMAS, B.S.,

JOHN F. HOUCK, B.S.,

Chemistry.

The course in Chemistry extends over a period of four years, and leads to the degree of Bachelor of Science in Chemistry. The tuition fee is two hundred dollars (\$200.00) a year.

The requirements for admission to this course are:

Subjects	Units
English	3
History	1
Math. A	1½
“ C	1
“ D	½
“ E	0*
“ F	½
Physics A	½
French A or German A	2
Electives	4½
Total	14½

*Math. E is required, unless F is offered, but no credit is given.

METHODS AND EQUIPMENTS.

The work of the first term of the first year consists in the execution of a somewhat extended series of experiments upon the metals and non-metals. The student omits only those of greater difficulty, and such as require a skilled manipulator for their performance. In addition, he attends lectures and recitations, and solves numerous examples based upon the various reactions that he conducts practically. The skill and familiarity with chemical methods, acquired in this way will fully prepare him for the work of the second term, which is mainly analytical, as also is the first term of the Sophomore year, though considerable time is allotted to the preparation of a selected series of inorganic salts.

In quantitative analysis he is given every opportunity to familiarize himself with purely scientific methods in gravimetric, electrolytic and volumetric analysis; also with gas analysis, the use of the spectroscope, and the methods of technical analysis applied in the various branches of Chemistry. The instruction in Theoretical Chemistry is given by lectures; that in Applied Chemistry by lectures, supplemented by frequent visits to the chemical plants in Philadelphia and adjacent cities. The lectures and recitations in Organic Chemistry are conducted parallel with practical work upon this subject. The aim is to have the student prepare typical substances from the whole field of Organic Chemistry. The most recent methods of analysis peculiar to this field receive due attention.

THE JOHN HARRISON LABORATORY OF CHEMISTRY provides a complete modern equipment for the prosecution of chemical studies, both undergraduate and graduate. A pamphlet containing plans of the Laboratory will be mailed upon application to the Director.

FRESHMAN CLASS.

Subjects	Number of hours a week		For a brief description, see	
	1st Term	2d Term	Page	Number
General Chemistry	18	—	112	Chem. 2
Qualitative Analysis	—	18	112	" 4
Algebra	4	—	127	Math. 31
Analytic Geometry and Calculus.....	—	4	127	" 32
German..... } one only {	{ 2	2	126	Ger. 2
	{ 1	1	126	" 3
	{ 2	2	124	Fr. 2
French..... } required {	{ 1	1	124	" 3
English Composition	2	2	122	Eng. 1
English Literature	—	2	123	" 40
Mechanical Drawing	2	—	132	M.E. 91
Elements of Engineering	—	2	133	" 92
Physics	3	3	134	Phys. 26
Physical Education	2	2	133	Phys. Ed. 1

SOPHOMORE CLASS.

Qualitative Analysis	18	—	112	Chem. 4
Quantitative Analysis	—	13	113	" 7
English Composition	1	1	122	Eng. 3
English Literature	2	2	123	" 42-43
German..... } one only {	3	3	126	Ger. 5-6
	2	2	126	" 10
	3	3	124	Fr. 4-5
Scientific German..... } required {	2	2	125	" 8
Scientific French.....	2	2	125	Min. 1
Mineralogy	2	2	125	
Physics	4	4	134	Phys. 27
Physical Education	2	2	133	Phys. Ed. 2

JUNIOR CLASS.

Quantitative Analysis	13	—	113	Chem. 7
Organic Chemistry	2	2	113	" 9
Assaying	4	4	114	" 17
Physical Chemistry	4	4	114	" 21
Inorganic Technical Analysis	—	13	114	" 22
Logic	—	2	133	Phil. 5c
German..... } one only {	2	2	127	Ger. 11
	2	2	125	Fr. 9
English Literature	2	2	124	Eng. 90-80
Mineralogy, Descriptive	2	2	125	Min. 2
Mineralogy, Determinative	2	2	125	" 3
Metallurgy	2	—	125	Met. 1
Physics	2	2	134	Phys. 28
Physical Education	2	2	133	Phys. Ed. 3

SENIOR CLASS.

Subjects	Number of hours a week		For a brief description, see	
	1st Term	2d Term	Page	Number
Organic Chemistry	3	3	113	Chem. 10
Practical Organic Chemistry	10	10	113	" 12
Applied Chemistry	2	2	113	" 13
Analysis of Foods	—	8	113	" 14
Theoretical Chemistry	1	1	113	" 15
Electro-Chemistry	1	1	114	" 16
Practical Electro-Chemistry	8	—	114	" 19
Geology	2	2	125	Geol. 3
Business Law	1	1	112	Bus. Law 1
English Literature	2	2	123	Eng. 70
Physical Education	2	2	133	Phys. Ed. 4

THE COURSE IN CHEMICAL ENGINEERING.

The Course in Chemical Engineering covers a period of four years, and leads to the degree of Bachelor of Science in Chemical Engineering. The tuition fee is two hundred dollars (\$200.00) a year. Graduates who continue in the practice of their profession may receive the technical degree of Chemical Engineer under the provisions stated on page 57.

The chemical studies introduced into this course will not only give the student a thorough acquaintance with the fundamental principles of chemical science, but will also afford him a complete drill in analysis, and in the preparation of inorganic and organic products. Instruction in technical analysis and applied chemistry is reserved until the last year. Frequent excursions are made to adjacent plants for the purpose of studying practical processes in operation, and examining in detail the mechanical appliances in use.

The requirements for admission to this course are:

Subjects	Units
English	3
History	1
Math. A	1½
“ C	1
“ D	½
“ E	0*
“ F	½
Physics A	½
French A or German A	2
Electives	4½
Total	14½

*Math. E is required, unless F is offered, but no credit is given.

FRESHMAN CLASS.

Subjects	Number of hours a week		For a brief description, see	
	1st Term	2d Term	Page	Number
General Chemistry	18	—	112	Chem. 2
Qualitative Analysis	—	14	112	" 5
Elementary Drawing	3	3	128	M.E. 1
Shop Work	3	3	129	" 3
English Composition	2	2	122	Eng. 2
English Literature	—	2	123	" 41
French..... } one only German..... } required	{ 2	2	124	Fr. 2
	{ 1	1	124	" 3
	{ 2	2	126	Ger. 2
	{ 1	1	126	" 4
Trigonometry	4	—	127	Math. 35
Algebra	—	4	127	" 36
Physics	3	—	133	Phys. 16
Physics	—	3	133	" 17
Physical Education	2	2	133	Phys. Ed. 1

SOPHOMORE CLASS.

Analytical Chemistry (Qualitative) ..	14	—	112	Chem. 5
Analytical Chemistry (Quantitative) ..	—	10	113	" 8
Elements of Engineering	2	—	129	M.E. 14
Kinematics	—	3	129	" 15
Mechanical Drawing and Sketching ..	3	3	129	" 11
Shop Work	3	3	129	" 13
English Composition	1	—	122	Eng. 4
English Literature	—	2	123	" 42
German..... } one only French..... } required	{ 2	2	124	Fr. 6
	{ 1	1	124	" 7
	{ 2	2	126	Ger. 8
	{ 1	1	126	" 9
Analytical Geometry }	{ 5	—	128	Math. 39
Calculus }	—	5	128	" 40
Electricity and Magnetism	3	—	134	Phys. 18
Physical Measurements	—	4	134	" 19
Analytical Mechanics	—	3	134	" 20
Physical Education	2	2	133	Phys. Ed. 2

JUNIOR CLASS.

Subjects	Number of hours a week		For a brief description, see	
	1st Term	2d Term	Page	Number
Analytical Chemistry (Quantitative) .	10	—	113	Chem. 8
Organic Chemistry	2	2	113	" 9
Assaying	—	4	114	" 18
Physical Chemistry	4	4	114	" 21
Inorganic Technical Analysis	—	10	114	" 23
Mechanics of Materials	4	—	129	M.E. 22
Graphics	—	3	132	" 71
Hydraulics	2	—	129	" 23
Thermodynamics	—	3	130	" 28
Mechanical Laboratory	3	3	130	" 26
Electrical Laboratory	3	3	121	E.E. 32
Elements of Electrical Engineering .	4	—	121	" 31
Electrical Machinery	—	3	121	" 33
Metallurgy	—	2	125	Met. I
Physical Education	2	2	133	Phys. Ed. 3

SENIOR CLASS.

Organic Chemistry	3	3	113	Chem. 10
Practical Organic Chemistry	10	10	113	" 12
Applied Chemistry	2	2	113	" 13
Electro-Chemistry	1	1	114	" 16
Practical Electro-Chemistry	6	—	114	" 20
Organic Technical Analysis	—	6	113	" 14
Industrial Applications of Electricity..	3	—	143	E.E. 41
Power Plants	4	—	131	M.E. 46
Applied Thermodynamics	1	—	132	" 82
Seminar	1	1	131	" 44
Machine Design	—	4	130	" 41
Mechanical Laboratory	—	3	132	" 84
Electrical Laboratory	3	—	130	" 43
Business Law	1	1	112	Bus. Law I
Physical Education	2	2	133	Phys. Ed. 4

THE COURSE IN CIVIL ENGINEERING.

OFFICERS.

EDGAR F. SMITH, PH.D., SC.D., L.H.D., LL.D., PROVOST.

JOSIAH H. PENNIMAN, PH.D., LL.D., VICE-PROVOST.

JOHN FRAZER, A.M., PH.D., DEAN OF THE TOWNE SCIENTIFIC SCHOOL.

EDGAR MARBURG, C.E., SC.D., LL.D., *Civil Engineering: Professor in Charge.*

WILLIAM EASBY, JR., C.E.,

EDWARD L. INGRAM, C.E.,

HERMAN C. BERRY, A.B., B.S. in C.E.,

WILLIAM C. H. SLAGLE, C.E.,

EDWARD T. GRANDLIENARD, B.S., C.E.,

WILLIAM S. PARDOE, B.A.Sc.,

WILLIAM T. LEGGO, C.E.,

C. LAURENCE WARWICK, B.S. in C.E.,

FRANK M. REGISTER, B.S. in C.E.,

ROBERT S. JOHNSTON, B.S. in C.E.,

THOMAS WICKS,

NORMAN V. BUREAU, B.S. in C.E.,

FRANK G. DEKER, B.S. in C.E.,

MARVIN Y. NEELY, B.S. in C.E.,

ABEL H. HILLMAN, B.S. in C.E.,

ROSS W. RITTER, B.S. in C.E.,

WM. R. FISHER,

DONALD S. MACBRIDE,

} *Engineering.*

The course in Civil Engineering extends over a period of four years, and leads to the degree of Bachelor of Science in Civil Engineering.

The tuition fee is two hundred dollars (\$200.00) a year. Graduates who continue in the practice of their profession may receive the technical degree of Civil Engineer under the provisions stated on page 57.

The requirements for admission to this course are:

Subjects	Units
English	3
History	1
Math. A	1½
“ C	1
“ D	½
Math. E	0*
“ F	½

*Math. E is required, unless F is offered, but no credit is given.

Subjects	Units
Physics A	½
French A or German A	2
Electives	4½
<hr/>	
Total	14½

A combined course, requiring six years, of broader scope than the four-year course, is offered in the College and the Civil Engineering Department. Information concerning this course appears on page 67.

METHODS AND EQUIPMENT.

The course in Civil Engineering is designed to meet, as thoroughly as practicable, the demands of engineering practice. The studies are sufficiently advanced and comprehensive to afford to the graduate that broad technical training essential to the successful prosecution of his subsequent professional work.

Text-books are used in general as a basis of instruction. Supplementary matter is given by lectures and in the form of notes. The aim is to keep the class work intimately in touch with the methods of current practice.

The equipment of surveying instruments includes two theodolites reading to single seconds by micrometer microscopes, two triangulation transits reading to twenty seconds, twelve engineers' transits, three precise levels, three dumpy levels, seven wye levels, two plane tables, three compasses, four sextants, and a large assortment of rods, tapes and minor instruments.

After the students have been made familiar with the adjustment and use of the various instruments, complete surveys are undertaken. During the first term a farm survey is made, in connection with the regular weekly field practice. During the summer, two entire weeks are devoted to a topographic and hydrographic survey, and a like period to the survey of a railroad line. The data collected in the field serve as a basis for subsequent class room instruction in the preparation of drawings and estimates.

The courses in the Theory of Stresses are supplemented by courses covering the practical application of the principles involved. Complete designs, accompanied by detail drawings, are made of a plate-girder and a pin-connected truss bridge. Similarly, the courses in the Theory of Hydraulics, Sanitary Engineering, Railroad Engineering and Masonry are followed by courses in the general design of a distributing system for a municipal water supply; the sewerage of a town; the elements of the design of railroad yards, terminals and track details, and the design of masonry structures.

The instruction relating to the Materials of Construction is supplemented by work in the Civil Engineering Testing Laboratories.

The largest machine in these laboratories has a capacity of 600,000 pounds. It is an Olsen vertical four-screw machine, of the universal type, capable of receiving a column twenty-four feet long, provided with beam extensions below the floor level twenty-one feet long designed for a load of 200,000 pounds on a span of twenty feet.

The remaining equipment consists of a 200,000-pound Olsen three-screw universal machine with beam extensions thirteen feet long, a 100,000-pound Olsen machine, two 30,000-pound Olsen machines, one 30,000-pound Falkenau-Sinclair machine, one 60,000-inch-pound torsion machine, an autographic pendulum torsion machine of the Thurston-Riehlé type, a 10,000-pound transverse machine, a cold-bend machine, capable of bending a steel bar one square inch in section, and a 15,000-pound wire-testing machine adapted also for receiving compression specimens up to a length of three feet. With the exception of the transverse, the wire-testing, and the pendulum-torsion machines designed for hand-operation, all of these machines are driven by independent electric motors.

These laboratories are further equipped with a great variety of special apparatus including two beam fiber extensometers; a Johnson, and a Ewing extensometer, the latter reading to 1-50,000 of an inch; an Olsen compressometer reading to 0.0001 inch, two deflectometers, a set of calibrating levers, standard weights, shearing apparatus for iron, steel and timber, besides a large assortment of micrometers, calipers, speed indicators and tools for the preparation and marking of specimens.

The Lesley Cement Laboratory is fully equipped for testing cement, sand, and plain and reinforced concrete. It contains four slate-top mixing tables each provided with a damp closet and scales.

The testing apparatus in this laboratory consists of an Olsen and a Riehlé machine of the lever type, a Fairbanks and a Falkenau-Sinclair machine of the shot type, and a 50,000-pound hand-power hydraulic machine for compression tests. It is further equipped with an Olsen mechanical briquette-molding machine; a Howard and Morse automatic sieve apparatus for cement and sand; a Bauschinger expansion apparatus; apparatus for accelerated tests; nine soap-stone immersion tanks; cement bins, briquette racks, and a very complete outfit of smaller apparatus including balances, specific gravity apparatus, sieves, burettes, briquette molds, etc.

Special provision is made for work in concrete, including molds for beams up to 13 feet long and a concrete immersion tank of suitable capacity for receiving these beams, a beam crane for their con-

venient handling and transportation, a concrete block for molding compression specimens, storage bins for stone, sand, etc.

The brick laboratory contains two rattlers for testing paving brick, which may be operated singly or jointly by an electric motor.

A large and well-equipped laboratory is provided for instruction and research in hydraulics. The most important features of the installation are as follows:

A concrete reservoir of 23,000 gallons capacity, which receives the discharge from all apparatus and from which the laboratory supply is drawn by two electrically-driven two-stage turbine pumps, each with a capacity of 450 gallons per minute against a head of 165 feet; and a low-lift centrifugal pump with a capacity of 2000 gallons per minute; a 3-inch double-suction centrifugal pump with a capacity of 300 gallons per minute against a head of 60 feet; a vertical circular pressure tank, $5\frac{1}{2}$ feet in diameter and 37 feet high, provided with attachments for orifices and other apparatus, a 12-inch standpipe 65 feet high with overflows to regulate the static head, circuits of 10-inch pipe, with numerous openings for the attachment of minor apparatus, connected with the standpipe and with the pressure tank, and two concrete weir tanks, each 34 feet long and 5 feet wide, which may be used also for measuring tanks. The latter may be converted into canals by opening the gates below the weir crests, for the purpose of investigating the flow over dams of various profiles. Two steel chutes are provided with valves operated by hydraulic cylinders to divert the flow alternately into two weighing tanks each of 16,000 pounds capacity, mounted on weighing cars, for weighing continuously the discharge from any part of the laboratory. The laboratory also contains a 9-inch reaction turbine, a 12-inch impulse wheel, water meters of various types, numerous gauges and a great variety of minor apparatus.

A well-equipped machine shop is provided for making and repairing apparatus and for preparing test specimens. Considerable special apparatus adapted to the particular requirements of the different laboratories has been made in the shop, under the immediate supervision of the various professors. Some of this apparatus was especially designed for use in research work in connection with Senior theses.

Tours of inspection to manufacturing plants and to engineering works, completed or in course of construction, are made from time to time during the year by the Junior and Senior classes, but only in so far as they have a direct bearing on the work of the class room.

Public lectures by prominent engineers are given monthly to the Senior and Junior classes in engineering.

During the summer vacation following the Junior year, each student is required to prepare a memoir descriptive of some engineering work or manufacturing plant, based on his direct personal inquiries and observation.

A thesis on a professional subject is required of every candidate for a degree. These theses must embody either a design or a review of an engineering plant, process or structure, or the results of an experimental investigation. They must be fully illustrated by drawings and models when needed, and upon graduation must be deposited with the University.

The department library contains an excellent collection of the most recent technical works, supplementing the very complete collection of bound volumes of engineering journals and of the transactions of engineering societies in the Fairman Rogers collection. The leading technical journals are kept on file.

THE COURSE IN CIVIL ENGINEERING.

FRESHMAN CLASS.

Subjects	Number of hours a week		For a brief description, see	
	1st Term	2d Term	Page	Number
Descriptive Geometry	3	3	114	C.E. 1
Lettering	2	—	114	" 2
Freehand Drawing	1	1	115	" 3
Mechanical Drawing	2	2	115	" 4
Topographical Drawing	—	3	115	" 6
Engineering Computations	1	—	118	" 50
Trigonometry	4	—	127	Math. 35
Algebra	—	4	127	" 36
Physics	3	—	133	Phys. 16
Physics	—	3	133	" 17
Physics	—	2	134	" 19
English Composition	2	2	122	Eng. 2
English Literature	—	2	123	" 41
German..... } only one {	{ 2	2	126	Ger. 2
French..... } required {	{ 1	1	126	" 4
	{ 2	2	124	Fr. 2
	{ 1	1	124	" 3
Chemistry	4	4	112	Chem. 1
Physical Education	2	2	133	Phys. Ed. 1

SOPHOMORE CLASS.

Mechanical Drawing	3	3	115	C.E. 5
Surveying, Theory	3	—	115	" 10
Surveying, Practice	3	3*	115	" 11
Railroad Surveying, Theory	—	3	115	" 12
Railroad Surveying, Practice	—	3*	115	" 13
Summer Surveying Practice	4 weeks vacation work		115	" 14
Analytical Geometry }	{ 5	—	128	Math. 39
Calculus }	{ —	5	128	" 40
Analytic Mechanics	—	3	134	Phys. 20
Physics	3	—	134	" 18
Physics	2	—	134	" 19
English Composition	—	1	122	Eng. 4
English Literature	2	—	123	" 42
German..... } only one {	{ 2	2	126	Ger. 8
French..... } required {	{ 1	1	126	" 9
	{ 2	2	124	Fr. 6
	{ 1	1	124	" 7
Chemistry (Qualitative)	4	4	112	Chem. 3
Physical Education	2	2	133	Phys. Ed. 2

*For half of the term.

JUNIOR CLASS.

Subjects	Number of hours a week		For a brief description, see	
	1st Term	2d Term	Page	Number
Map Drawing	2	—	115	C.E. 7
Railroad Construction and Maintenance	2	—	116	" 15
Railroad Office Work	2	—	116	" 16
Hydromechanics	4	—	116	" 25
Hydraulic Testing	3*	3*	116	" 26
Water-Supplies	—	2	117	" 27
Sanitary Engineering	—	2	117	" 28
Materials of Construction	—	2	117	" 35
Materials Testing	3*	3*	117	" 36
Mechanics of Materials	5	—	117	" 40
Graphic Statics	—	1	117	" 41
Framed Structures	—	5	117	" 42
Bridge Design	—	3	118	" 44
Masonry	3	—	118	" 46
Monthly Lectures by visiting Engineers			118	Spec. Lect. 1
Astronomy	—	3	112	Astr. 2
Geology	—	2	125	Geol. 9
Mineralogy	2	—	125	Min. 6
Physical Education	2	2	133	Phys. Ed. 3

SENIOR CLASS.†

Railroad Economics	2	—	116	C.E. 17
Railroad Design	2	—	116	" 18
Geodesy, Theory	—	2	116	" 19
Geodesy, Practice	—	3	116	" 20
Hydraulic Works Design	5	—	117	" 29
Roads and Pavements	2	—	117	" 30
Cement Testing	3	—	117	" 37
Framed Structures	4	—	118	" 43
Bridge Design	3	5	118	" 45
Masonry Design	—	3	118	" 47
Reinforced Concrete	4	—	118	" 48
Monthly Lectures by visiting Engineers			118	Spec. Lect. 1
Thesis	—	6	118	C.E. 53
Business Law	—	2	112	Bus. Law 1
Applied Electricity	3	—	122	E.E. 51
Steam Engines and Boilers	—	4	133	M.E. 93
Metallurgy	—	2	125	Met. 1
Physical Education	2	2	133	Phys. Ed. 4

*For half of the class each term.

†A Summer Memoir is required for admission to full standing in the Senior Class. For a brief description see page 118, number 52.

THE COURSE IN ELECTRICAL ENGINEERING.

OFFICERS.

EDGAR F. SMITH, PH.D., SC.D., L.H.D., LL.D., PROVOST.

JOSIAH H. PENNIMAN, PH.D., LL.D., VICE-PROVOST.

JOHN FRAZER, A.M., PH.D., DEAN OF THE TOWNE SCIENTIFIC SCHOOL.

HAROLD PENDER, PH.D., *Electrical Engineering, Professor in Charge.*

C. E. CLEWELL, E.E., *Electrical Engineering.*

HOWARD M. TRUEBLOOD, PH.D., *Electrical Engineering.*

CHESLEY H. JOHNSON, M.E., *Electrical Engineering.*

JESSE B. STRAW, B.S. in E.E., *Electrical Engineering.*

ROY KEGGERREIS, M.E. in E.E., *Electrical Engineering.*

RALPH J. DALY, B.E.E., *Electrical Engineering.*

WILLIAM F. JOHNSON, B.S. in E.E., *Electrical Engineering.*

CHARLES D. FAWCETT, B.S. in E.E., *Electrical Engineering.*

EDWIN R. MARTIN, B.S. in E.E., *Electrical Engineering.*

ROBERT B. FINLEY, E.E., *Electrical Engineering.*

The course in Electrical Engineering covers a period of four years, and leads to the degree of Bachelor of Science in Electrical Engineering.

Graduates of this course who continue in the practice of their profession receive the technical degree of Electrical Engineer three years after the Bachelor's degree has been conferred, upon presentation of an acceptable thesis. (See page 57.)

New students are admitted to advanced standing, provided they have pursued similar courses elsewhere.

The tuition fee for the courses in Electrical Engineering is two hundred dollars (\$200.00) a year.

SCOPE OF COURSES.

The instruction in the course of Electrical Engineering comprises lectures, recitations, laboratory practice, drafting, shopwork and excursions. Throughout the course emphasis is laid upon the application of fundamental principles to engineering problems. In general, the schedules are so arranged that one-half of each day is devoted to the work of the classroom and the other half to the more practical labors of the drawing room, the shop, and the laboratory.

The combination of lecture and recitation courses and practical work is designed to give the student such a fundamental knowledge of the apparatus and methods used in developing, transmitting and utilizing electric power, and in the allied branches of engineering,

that he will be able to take up after graduation any of the general divisions of Electrical Engineering.

The work of the first two years is the same in the Electrical Department as in the Mechanical Department, and consists largely of training in chemistry, physics, mathematics, and modern languages. During the Junior and Senior years the studies deal chiefly with the fundamentals of electrical engineering and their application in the design and performance of electrical apparatus, machinery and systems.

These subjects may be broadly classified under the heads of dynamo-electric machinery, distribution and transmission, electric railways, illumination, and industrial applications of electric power. In addition, instruction is given in the Senior and Junior years in those branches of mechanical engineering, heat engineering, hydraulic engineering and surveying which have a direct bearing on electrical engineering practice. Courses in business law and economics are also given.

EXCURSIONS.

Throughout the four years, occasional visits are made to power plants and manufacturing establishments to enable the student to become familiar with the production and utilization of electric energy on a commercial scale.

During the Senior year at least one out-of-town excursion is made. In the spring of 1915 and thereafter, such an out-of-town trip is required of all Senior Students in Electrical Engineering. This required trip will take about one week, and the expense per student will probably range from \$50.00 to \$75.00, depending somewhat upon his personal expenditures.

EQUIPMENT.

Instruction in technical subjects is given in the Engineering Building, which is exceptionally well equipped with the apparatus and facilities needed for instruction in Electrical Engineering.

A separate drawing room is assigned to each class, and a separate desk is assigned to each student as far as possible, no desk being occupied by more than two students. The drawing rooms are admirably lighted and are available for study purposes at all times during the day. All class rooms and drawing rooms are used jointly with the Department of Mechanical Engineering.

The electrical laboratories at present occupy three divisions of the Engineering Building. One is used for instruction in technical electrical measurements and in standardization work. Another is devoted to investigations of direct current generators, motors and railway equipment. The third division provides for work with alternating current machinery and for photometry.

LIBRARY.

The Electrical, Mechanical and Civil Engineering Departments share a common library in the Engineering Building. This departmental library is well supplied with books, technical journals, and transactions of the leading engineering societies.

NOTE.—A description of the Engineering Building and of the details of the equipment and methods of instruction are given in a separate bulletin entitled "Courses in Engineering" which may be obtained upon application.

THE COURSE IN ELECTRICAL ENGINEERING.

The requirements for admission to this course are as follows:

Subjects	Units
English	3
History	1
Math. A	1½
" B	1
" C	1
" D	½
" E	0*
" F	½
Physics A	½
French A or German A	2
Electives	4½
Total	14½

This course leads to the degree of B.S. in Electrical Engineering at the end of the Senior year. The technical degree of E.E. is conferred under the provisions stated on page 97.

FRESHMAN CLASS.

Subjects	Number of Hours a week		For a brief description, see	
	1st Term	2d Term	Page	Number
Elementary Drawing	3	3	128	M.E. 1
Shop Work	6	6	129	" 2
Descriptive Geometry	3	3	118	C.E. 60
English Composition	2	2	122	Eng. 2
English Literature	—	2	123	" 41
French	3	3	124	Fr. 2-3
German	3	3	122	Ger. 2-4
Trigonometry	4	—	127	Math. 35
Algebra	—	4	127	" 36
Physics	3	—	133	Phys. 16
Physics	—	3	133	" 17
Chemistry	4	4	112	Chem. 1
Physical Education	2	2	133	Ph. Ed. 1

*Math. E is required, unless F is offered, but no credit is given.

SOPHOMORE CLASS.

Mechanical Drawing and Sketching	3	3	129	M.E. 11
Shop Work and Shop Visits	6	3	129	" 12
Elements of Engineering	2	—	129	" 14
Kinematics	—	3	129	" 15
English Composition	1	—	122	Eng. 4
English Literature	—	2	123	" 42
French	3	3	124	Fr. 6-7
German	3	3	126	Ger. 8-9
Analytic Geometry	5	5	128	Math. 39
Calculus	5	5	128	" 40
Physics	3	—	133	Phys. 18
Physical Measurements	—	4	133	" 19
Analytic Mechanics	—	3	133	" 20
Chemistry	4	4	112	Chem. 3
Physical Education	2	2	133	Ph. Ed. 2

JUNIOR CLASS.

Subjects	Number of hours a week		For a brief description, see	
	1st Term	2d Term	Page	Number
Working Drawings	3	—	129	M.E. 21
Mechanics of Materials	4	—	129	" 22
Hydraulics	2	—	129	" 23
Machine Design and Kinematic Design..	3	4	130	" 25
Mechanical Laboratory	3	3	130	" 26
Thermodynamics	—	3	130	" 28
Graphics	—	3	132	" 71
Principles of Electrical Engineering ...	5	—	119	E.E. 1
Electrical Measurements	2	2	119	" 2
Electrical Laboratory	4	7	119	" 3
Alternating Currents	—	4	119	" 4
Surveying, Theory and Practice	—	3	118	C.E. 61-62
Differential Equations	3	—	128	Math. 43
Physical Education	2	2	133	Ph. Ed. 3
Special Lectures	—	—	121	Sp. Lect.

SENIOR CLASS.

Power Plants	4	—	131	M.E. 46
Hydraulic Engineering	2	—	132	" 81
Heat Engineering	2	—	132	" 85
Mechanical Laboratory	3	3	132	" 83
Electrical Measurements*	—	2	119	E.E. 2
Illumination	2	—	120	" 11
Seminar	1	1	120	" 12
Electric Power Plants	—	3	120	" 13
Electric Railways†	—	3	120	" 14
Motor Applications†	—	3	120	" 15
Distribution and Transmission†	2	—	120	" 16
Alternating Current Machinery	4	4	120	" 17
Electric Machinery Laboratory	7	4	121	" 18
Thesis	—	9	121	" 19
Telegraphy and Telephony	—	3	121	" 20
Business Law	2	—	112	B.L. 1
Economics	—	2	121	E. of B. 1
Physical Education	2	2	133	Ph. Ed. 4
Special Lectures	—	—	121	Sp. Lect.

*For the year 1914-15 only.

† Choice of two out of three.

THE COURSE IN MECHANICAL ENGINEERING.

OFFICERS.

EDGAR F. SMITH, PH.D., SC.D., L.H.D., LL.D., PROVOST.

JOSIAH H. PENNIMAN, PH.D., LL.D., VICE-PROVOST.

JOHN FRAZER, A.M., PH.D., DEAN OF THE TOWNE SCIENTIFIC SCHOOL.

ROBERT H. FERNALD, B.M.E., M.E., A.M., PH.D., *Dynamical Engineering: Professor in Charge.*

J. VERNE STANFORD, B.S., M.E., *Mechanical Engineering.*

GEORGE E. CROFOOT, B.S. in M.E., *Mechanical Engineering.*

ELMER BARK, B.S., *Mechanical Engineering.*

MYRLE C. EVANS, B.S., in M.E., *Mechanical Engineering.*

GEORGE E. HAGEMANN, B.S. in M.E., *Mechanical Engineering.*

HAROLD S. ORR, M.E., *Mechanical Engineering.*

CHRISTIAN C. SCHLUDERBERG, M.E., *Mechanical Engineering.*

HENRY E. EHLERS, B.S. in M.E., *Experimental Engineering.*

GEORGE S. WHEATLEY, B.S. in M.E., *Mechanical Engineering.*

PAUL J. KIEFER, A.B., B.S. in M.E., *Mechanical Engineering.*

GEORGE B. WHAREN, B.S., M.E., *Mechanical Engineering.*

SHERRILL S. RATHBUN, A.B., M.E., *Mechanical Engineering.*

HORACE P. FREY, B.S. in E.E., *Mechanical Drawing.*

MILTON S. GRAWL, *Mechanical Drawing.*

JOHN F. ALLISON, B.S. in M.E., *Mechanical Drawing.*

CHARLES A. JOHNSON, B.S. in M.E., *Mechanical Drawing.*

LELAND W. BENNETT, B.S. in E.E., *Mechanical Drawing.*

GEORGE W. ARNOLD, JR., *Mechanical Drawing.*

ADOLPH GELPKE, *Mechanical Drawing.*

JOHN J. MORRIS, *Mechanical Constructive Practice.*

GEORGE W. H. FAWKES, *Wood-working.*

JOSEPH L. MOUNCE, *Wood-working.*

PERCIVAL R. HALL, *Iron-working.*

ROBERT H. KREWSON, *Iron-working.*

SAMUEL APPLIN, *Iron-working.*

CHARLES W. BLOEMKER, *Forging.*

JOHN F. MURPHY, *Iron Founding.*

The course in Mechanical Engineering covers a period of four years, and leads to the degree of Bachelor of Science in Mechanical Engineering.

Graduates of this course who continue in the practice of their profession receive the degree of Mechanical Engineer three years after the Bachelor's degree has been conferred, upon presentation of an acceptable thesis. (See page 57.)

New students are admitted to advanced standing, provided they have pursued similar courses elsewhere.

The tuition fee for the course in Mechanical Engineering is two hundred dollars (\$200) a year.

SCOPE OF COURSE.

The instruction in the course of Mechanical Engineering comprises lectures, recitations, laboratory practice, drafting, shop-work and excursions. The time allotted is so arranged as to give the student a general acquaintance with the principles involved. In general, the schedules are so arranged that one-half of each day is devoted to the work of the class room and the other half to the more practical labors of the drawing room, the shop, and the laboratory.

The combination of lecture and recitation courses and practical work is designed to give the student such a fundamental knowledge of the apparatus and methods used in developing, transmitting and utilizing power, that he will be able to take up after graduation any of the general divisions of Mechanical Engineering.

The work of the first two years consists largely of training in chemistry, physics, mathematics, and modern languages. During the Junior and Senior years the studies are almost purely technical in character and may be broadly classified under the heads of mechanics, thermodynamics, electrodynamics, design, power measurement, and plant installation and equipment.

EXCURSIONS.

Throughout the four years, occasional visits are made to the shops and manufacturing establishments of Philadelphia and vicinity to enable the student to become familiar with the progress of manufacturing, the arrangement of machinery and the mechanism of the machinery itself.

During the Senior year, at least one out of town excursion is made. For the years 1912-1913 and 1913-1914, optional trips were made during the Easter recesses. In the spring of 1915 and thereafter, such out of town trips will be required of students in Mechanical Engineering.

The 1913 trip covered points of especial engineering interest in Pittsburgh, Cleveland, Toledo, Niagara Falls, Schenectady and New York City. In the spring of 1914, the places visited included Pittsburgh, St. Louis, Keokuk, Chicago and Detroit.

The required trip for the spring of 1915 occupied two weeks, and the places visited were Pittsburgh, Cleveland, Akron, St. Louis, Keokuk, Chicago, Detroit and Buffalo. The expense involved by such excursions usually ranges from \$75.00 to \$110.00 for each student, depending somewhat upon his personal expenditures.

EQUIPMENT.

Instruction in technical subjects is given in the Engineering Building, which is exceptionally well equipped for theoretical and practical instruction in Mechanical Engineering.

A separate drawing room is assigned to each class, and a separate desk is assigned to each student as far as possible, no desk being occupied by more than two students. The rooms are admirably lighted and are available for study purposes at all times during the day.

The mechanical laboratory, located on the first floor, is divided into sections devoted to the investigation of problems in hydraulics, materials of construction, gas engineering, boiler testing, refrigeration, heating and ventilation, and steam engineering.

The shops consist of a forge shop, foundry, iron-working and pattern shops with complete equipment.

LIBRARY.

The Mechanical, Electrical and Civil Engineering Departments share a common library in the Engineering Building. This departmental library is well supplied with books, technical journals, and transactions of the leading engineering societies.

NOTE.—A description of the Engineering Building and of the details of the equipment and methods of instruction are given in a separate bulletin, entitled "Courses in Engineering", which may be obtained upon application.

THE COURSE IN MECHANICAL ENGINEERING.

The requirements for admission to this course are as follows:

Subjects	Units
English	3
History	1
Math. A	1½
" C	1
" D	½
" E	0*
" F	½
Physics A	½
French A or German A	2
Electives	4½
Total	14½

This course leads to the degree of B.S. in Mechanical Engineering at the end of the Senior year. The technical degree of M.E. is conferred under the provisions stated on page 57.

FRESHMAN CLASS.

Subjects	Number of hours a week		For a brief description, see	
	1st Term	2d Term	Page	Number
Elementary Drawing	3	3	128	M.E. 1
Shop Work	6	6	129	" 2
Descriptive Geometry	3	3	118	C.E. 60
English Composition	2	2	123	Eng. 2
English Literature	—	2	123	" 41
French..... } one only {	3	3	124	Fr. 2-3
German..... } required {	3	3	126	Ger. 2-4
Trigonometry	4	—	127	Math. 35
Algebra	—	4	127	" 36
Physics	3	—	133	Phys. 16
Physics	—	3	133	" 17
Chemistry	4	4	112	Chem. 1
Physical Education	2	2	133	Ph. Ed. 1

*Math. E is required, unless F is offered, but no credit is given.

SOPHOMORE CLASS.

Mechanical Drawing and Sketching.	3	3	129	M.E. 11
Shop Work and Shop Visits	6	3	129	" 12
Elements of Engineering	2	—	129	" 14
Kinematics	—	3	129	" 15
English Composition	1	—	122	Eng. 4
English Literature	—	2	123	" 42
French..... } one only {	3	3	124	Fr. 6-7
German..... } required {	3	3	126	Ger. 8-9
Analytic Geometry	5	5	128	Math. 39
Calculus	5	5	128	" 40
Physics	3	—	133	Phys. 18
Physical Measurements	—	4	133	" 19
Analytic Mechanics	—	3	133	" 20
Chemistry	4	4	112	Chem. 3
Physical Education	2	2	133	Ph. Ed. 2

JUNIOR CLASS.

Subjects	Number of hours a week		For a brief description, see	
	1st Term	2d Term	Page	Number
Working Drawings	3	—	129	M.E. 21
Mechanics of Materials	4	—	129	" 22
Hydraulics	2	—	129	" 23
Seminar	1	1	130	" 24
Machine Design and Kinematic Design	3	3	130	" 25
Mechanical Laboratory	3	3	130	" 26
Graphics	—	5	130	" 27
Thermodynamics	—	3	130	" 28
Elements of Electrical Engineering	4	—	121	E.E. 31
Electrical Laboratory	3	3	121	" 32
Electric Machinery	—	3	121	" 33
Surveying, Theory and Practice	—	3	118	C.E. 61-62
Metallurgy	—	2	125	Met. 1
Physical Education	2	2	133	Ph. E. 3
Special Lectures	—	—	121	Sp. Lec.

SENIOR CLASS.

Crane Design	4	—	130	M.E. 41
Hydrodynamics	2	—	130	" 42
Applied Thermodynamics	3	—	130	" 43
Seminar	1	1	131	" 44
Mechanical Laboratory	7	2	131	" 45
Power Plants	—	4	131	" 46
Thesis	—	9	131	" 47
Inspection Trip	—	—	131	" 48
Steam Engine	3	—	131	" 51
Steam Turbine	—	3	131	" 52
Steam Machinery Design	—	6	131	" 53
Heating and Ventilation	3	—	132	" 54
*Marine Engines or Naval Architecture	—	2	132	" 61-62
Industrial Applications of Electricity	3	—	121	E.E. 41
Electric Machinery Laboratory	3	—	122	" 42
Business Law	2	—	112	B.L. 1
Economics	—	2	121	E. of B. 1
Physical Education	2	2	133	Ph. Ed. 4
Special Lectures	—	—	121	Sp. Lec.

* Alternate years. M. E. 62 omitted in 1915-16.

ARCHITECTURE.

ARCHITECTURE 1. *Design*.—Grade I. Problems in elementary design involving the use of the elements. These problems are co-ordinated to the lectures in 9 and 10. One unit. Ten hours. MR. HOLLAND and MR. BACON.

ARCHITECTURE 2. *Design*.—Grade II. Exercises in architectural composition and in rendering, involving the application of the principles of architectural drawing. Sketch problems in the elementary design of the small ensemble. Four units. Fifteen hours. MR. ROBINS and MR. HOLLAND.

ARCHITECTURE 3. *Design*.—Grade III. Problems in elementary design of the small ensemble and in the design of architectural motifs; two to four weeks each. Four units. Fifteen hours. MR. MCGOODWIN and MR. ROBINS.

ARCHITECTURE 4 and 5. *Design*.—Grades IV and V. Problems in (a) the design of component motifs of architectural composition, (b) the design of the ensemble; three to four weeks each. One-day sketch problems in decorative architecture. Grade IV, five units, twenty-two hours, ASSISTANT PROFESSOR BICKLEY, MR. MCGOODWIN and MR. ROBINS. Grade V, five units, twenty-two hours, ASSISTANT PROFESSOR BICKLEY and ACTING PROFESSORS DAVIS, SEELER and VAN PELT.

ARCHITECTURE 6. *Design*.—Grade VI. Problems in the composition of the ensemble four to five weeks each; in plan composition, and in the composition of interiors. One-day sketch problems in plan composition. Fifteen units. Thirty hours. ACTING PROFESSORS DAVIS, SEELER and VAN PELT.

Design Judgments.—During the year of 1913-14, the following architects served in judgments upon the work in design by the upper classes of the School; namely, Messrs.:

Leon Arnal,	R. R. McGoodwin,
George H. Bickley,	John Molitor,
Arthur H. Brockie,	Chas. F. Rabenold,
Paul P. Cret,	W. Powell Robins,
Leicester B. Holland,	Arthur H. Truscott,
Warren P. Laird,	J. S. Warner,

Henry D. Wood.

ARCHITECTURE 9 and 10. *The Elements of Architecture*.—(9) Lectures on the Five Orders, their affiliated forms and derivatives and other elements of Renaissance design, accompanied by exercises in drawing and rendering. (10) Lectures on Architectural Features, Wall Treatments, Arches, Vaults, etc., treated with reference to their employment in Architectural Composition. The problems in Grade I Design are co-ordinate to these lectures. Course 9, one and one-

half units, two hours, PROFESSOR LAIRD. Course 10, one-half unit, one hour, ASSISTANT PROFESSOR GUMAER. *Drawing*, MR. BACON, MR. HOLLAND and assistants.

ARCHITECTURE 11 and 12. *Freehand Drawing*.—Grades I and II. Outline representations of simple objects, in groups, as exercises in developing the powers of observation as well as in the training of the hand. Elementary drawing in charcoal from grouped objects and from casts, etc., as exercises in representations of the third dimension. Grades I and II, each one unit, each four hours, PROFESSOR DAWSON and assistants.

ARCHITECTURE 13 and 14. *Freehand Drawing*.—Grades III and IV. Drawing in charcoal from casts of architectural ornament, architectural fragments, and parts of the figure. Grades III and IV, each one unit, each four hours, PROFESSOR DAWSON and assistants.

ARCHITECTURE 15. *Freehand Drawing*.—Grade V. Charcoal drawing from reproductions of antique figures. One unit. Four hours. PROFESSOR DAWSON and assistants.

ARCHITECTURE 16. *Freehand Drawing from the Life*.—Grade VI. Two units. Four hours. MR. OAKLEY.

ARCHITECTURE 20. *Freehand Drawing*.—Grade VI. From motifs in historic ornament, involving composition. One unit. Four hours. PROFESSOR EVERETT.

ARCHITECTURE 21 and 22. *Water-Color Drawing*.—Grades I and II. Exercises in the handling of the medium and in translation of color. Grades I and II, each one unit, each three hours, PROFESSOR DAWSON.

ARCHITECTURE 23 and 24. *Water-Color Rendering*.—Grades III and IV. Studies in rendering: First, of architectural objects; second, of photographic subjects. Grades III and IV, each one unit, each three hours, PROFESSOR DAWSON.

ARCHITECTURE 26. *Architectural Drawing*.—Exercises in (a) instrumental drawing, (b) pen and pencil drawing, (c) brush work, and (d) lettering; with particular application to architectural subjects. One unit. Twelve hours. MR. BACON, MR. HOLLAND and assistants.

ARCHITECTURE 27. *Descriptive Geometry*.—Orthographic projections; revolutions; single and double curved surfaces of revolution; intersections of lines, planes and solids; tangents and developments. Lectures and exercises. Two units. Six hours. ASSISTANT PROFESSOR WHITNEY and assistant. (The subjects of shades and shadows and perspective are separately treated, as follows.)

ARCHITECTURE 28. *Shades and Shadows*.—Lectures and exercises, with especial emphasis upon the theory of Descriptive Geometry as involved in problems relating particularly to architectural practice. One unit. Six hours. ASSISTANT PROFESSOR WHITNEY and assistant.

ARCHITECTURE 29. *Perspective*.—Lectures and exercises, with especial emphasis upon the theory of Descriptive Geometry and Shades and Shadows as involved in problems relating particularly to architectural practice. One unit. Six hours. ASSISTANT PROFESSOR WHITNEY and assistant.

ARCHITECTURE 30. *Mechanics of Architectural Construction*.—Nature, properties and strength of the materials used in architectural construction; special application of the principles of mechanics to buildings and structural parts of buildings, such as beams, girders, columns, trusses, arches, etc. Two units. Five hours. PROFESSOR NOLAN.

ARCHITECTURE 31. *Graphic Statics in Architecture*.—Special applications of graphic methods to the analysis of stresses in different kinds of architectural construction, such as beams, trusses, piers, arches, abutments, etc., and investigations relating to the stability of buildings and structural parts of buildings. Two units. Seven hours. PROFESSOR NOLAN, MR. PARKER.

ARCHITECTURE 32. *Carpentry*.—Nature and properties of woods used in buildings. Carpentry, heavy framing and mill-construction. Lectures and drawing. (32 and 33 form a two-year course, 33 being given in 1914-15.) Two units. Three hours. PROFESSOR NOLAN, MR. PARKER.

ARCHITECTURE 33. *Masonry and Ironwork*.—Nature and properties of materials used in masonry. Masonry and ordinary foundations; ironwork and steelwork; concrete work. Lectures and drawing. (32 and 33 form a two-year course, 32 being given in 1915-16.) Two units. Three hours. PROFESSOR NOLAN, MR. PARKER.

ARCHITECTURE 34 and 35. *Building Sanitation*.—34, Heating and Ventilation; 35, Plumbing and Drainage. Preceded by Hygiene 1. Scientific principles of Sanitary Engineering and their application in building-practice. One unit. PROFESSOR NOLAN, ASSISTANT PROFESSOR BERGEY.

ARCHITECTURE 36. *Strength of Materials*.—The elementary principles of the mechanics of materials used in carpentry, masonry and ironwork. Lectures and problems adapted to the special students. Practice in the use of architects' and engineers' handbooks. Two units. Three hours. PROFESSOR NOLAN.

The following subjects, together with those numbered 141, 142 and 143, constitute the Option in Advanced Architectural Construction:

ARCHITECTURE 37. *Architectural Construction: Design*.—Practical problems of four to five weeks each in architectural, constructive design. Buildings designed and analyzed as structural units and the details in each problem carefully worked out. Six units. Twenty-six hours. PROFESSOR NOLAN.

ARCHITECTURE 38. *Architectural Construction. Design; Thesis.*—And extended problem in architectural, constructive design, consisting of a subject chosen by the student with the approval of the Professor of Architecture, descriptive memoir and specification accompanying the design. Six units. Twenty-six hours. PROFESSOR NOLAN.

ARCHITECTURE 39. *Architectural Construction: Theory.*—Typical skeleton structures. Plans of column, girder and beam-framing. Details of framed, metal connections. Plate girders and box girders. Wind-bracing. Truss-design and details. Latest fireproofing methods. Reinforced concrete construction. Four units. Six hours. PROFESSOR NOLAN.

ARCHITECTURE 40. *Foundations of Buildings.*—Consideration of special problems relating to foundations for heavy buildings. Pile foundations. Grillage. Masonry wells and caissons. Cantilever foundations. Foundations under water. One unit. Three hours. PROFESSOR NOLAN.

ARCHITECTURE 41. *Specifications, Estimates and Contracts.*—General and special clauses of architects' specifications for the different kinds of material and labor. Forms of contracts and their relations to building operations. Examinations and comparison of typical and model forms. Practice in writing specifications. Methods of estimating cost of labor and materials for the different kinds of architectural construction. One unit. Three hours. PROFESSOR NOLAN.

ARCHITECTURE 43. *History of Architecture.*—From the prehistoric age to the Fifteenth Century. Lectures, two hours; research, two hours. Three units. Four hours. ASSISTANT PROFESSOR GUMAER.

ARCHITECTURE 44. *History of Renaissance and Modern Architecture.*—From Brunelleschi to the close of the Nineteenth Century. Lectures, two hours; research, one hour. One and one-half units. Three hours. ASSISTANT PROFESSOR GUMAER.

ARCHITECTURE 45. *History of Painting.*—A course of lectures upon the history of painting. One unit. One hour. PROFESSOR EVERETT.

ARCHITECTURE 46. *History of Sculpture.*—A course of lectures upon the history of sculpture. One unit. One hour. PROFESSOR EVERETT.

ARCHITECTURE 47. *Professional Ethics and Practice.*—Aspects and problems of practice; professional ethics, competitions, preliminary cost computations, utilities in the planning of schools, libraries, court-houses, etc., etc. Lectures and research. One unit. One hour. PROFESSOR LAIRD.

ARCHITECTURE 48. *Special Lectures on Architectural and Allied Subjects.* One unit. One hour.

ARCHITECTURE 49. *Composition and the Theory of Design*.—A review of the basic principles of design followed by an analytical study of the compositions of noted plans and buildings, ancient and modern, and extended by discussion of the current problems in design. Lectures. One unit. One hour. ACTING PROFESSOR VAN PELT.

AS GIVEN 1913-14:

Design and Histroy.—Twelve lectures, viz.:

Introduction to the Study of Decorative Art, one lecture, by Alfred H. Gumaer, University of Pennsylvania.

Some Recent Discoveries in Greek Buildings, one lecture, by Professor W. N. Bates, University of Pennsylvania.

Stained Glass, one lecture, by William Willet, Philadelphia.

Restoration of Congress Hall, Independence Square, Philadelphia, one lecture, by Frank Miles Day, Philadelphia.

Composition, one lecture, by John V. Van Pelt, New York.

Early American Architecture, one lecture, by Professor G. B. Gordon, University of Pennsylvania.

Proportions and Decorative Use of the Human Figure, two lectures, by R. Tait McKenzie, M.D., University of Pennsylvania.

Planning of Railroad Stations, one lecture, by A. H. Granger, Philadelphia.

Twelfth and Thirteenth Century Stained Glass, one lecture, by Leicester B. Holland, University of Pennsylvania.

Life in Rome Under the Empire, two lectures, Professor W. B. McDaniel, University of Pennsylvania.

Construction and Practice.—Thirteen lectures, viz.:

Composition and Weathering of Building Stones, two lectures, by Frederick Ehrenfeld, University of Pennsylvania.

The Weathering of Building Stones, two lectures, by Amos Peaslee Brown, University of Pennsylvania.

The Theory and Practice of Reinforced Concrete, four lectures, by Emile G. Perrot, Philadelphia.

Facts Regarding Paint and Its Value as a Preservative for Structural Materials, one lecture, by H. A. Gardner, Washington, D. C.

The Architecture of The Garden Cities and Civic Center Planning, two lectures, by Carol Aronovici, Philadelphia.

The Architecture of Japan, one lecture, by Professor Warren P. Laird, University of Pennsylvania.

Observations Upon Burned Clay as a Decorative Material, one lecture, by J. H. Dulles Allen, Philadelphia.

AS OFFERED IN 1914-15:

History, Housing and Town Planning, Decoration and Landscape Design.—Twenty-two lectures, viz.:

Twelfth and Thirteenth Century Stained Glass, one lecture, by Leicester B. Holland, University of Pennsylvania.

Housing and Town Planning, ten lectures, by Dr. Carol Aronovici, Philadelphia.

The Decorative Element in Architecture, one lecture, by William Franklyn Paris, New York City.

Landscape Design, ten lectures, by George Burnap, Washington, D. C.

ASTRONOMY.

ASTRONOMY 2. *Astronomy.*—Young's *Manual of Astronomy*. Prerequisites, Mathematics 1 and 2. Three hours. First term. One and a half units. PROFESSOR DOOLITTLE and ASSISTANT PROFESSOR BARTON.

BUSINESS LAW.

BUSINESS LAW 1. (Towne Scientific School.) The law and principles of contracts, negotiable instruments, agency, partnerships, corporations, and the sale and transfer of real and personal property, and the discussion of forms and problems thereunder. One hour, both terms, or two hours, one term. MR. LICHTENBERGER, MR. ROBEY.

CHEMISTRY.

CHEMISTRY 1. *General Inorganic Chemistry.*—Recitation, conversational lectures and laboratory work. Experiments illustrating the principles of Chemistry. Two hours lecture and recitation and two hours laboratory. Both terms. Three units. PROFESSOR SMITH, ASSISTANT PROFESSOR McCUTCHEON, ASSISTANT PROFESSOR FRAZER, DR. MÜLLER, MR. ALEXANDER, MR. FITZPATRICK, MR. GRAFTON, MR. THOMAS, MR. HOUCK.

CHEMISTRY 2. Same as 1. Given in greater detail. Intended for students pursuing chemistry as a major subject. One hour lecture, five hours recitation and twelve hours laboratory. First term. PROFESSOR SMITH, ASSISTANT PROFESSOR McCUTCHEON, ASSISTANT PROFESSOR FRAZER, DR. MÜLLER, MR. FITZPATRICK.

CHEMISTRY 3. *Analytical Chemistry.*—Qualitative Analysis. Laboratory practice with lectures and recitations. Prerequisite, Chemistry 1. Two hours lecture and recitation and two hours laboratory. Both terms. Three units. PROFESSOR SMITH, DR. PLUMMER, MR. SWEENEY, MR. LEIGHNINGER.

CHEMISTRY 4. This course is to 3 what 2 is to 1. For Chemists. Prerequisite, Chemistry 2. Three hours lecture and recitation and fifteen hours laboratory. Both terms. PROFESSOR SMITH, DR. PLUMMER, MR. SWEENEY, MR. LEIGHNINGER.

CHEMISTRY 5. Similar to 4. For Chemical Engineers. Prerequisite, Chemistry 2. Three hours lecture and recitation. Eleven hours laboratory. Both terms. PROFESSOR SMITH, DR. PLUMMER, MR. SWEENEY, MR. LEIGHNINGER.

CHEMISTRY 6. *Analytical Chemistry*.—Quantitative Analysis. Gravimetric and volumetric analysis, with drill in mineral analysis. Prerequisite, Chemistry 3. One hour lecture and four hours laboratory. Both terms. Three units. PROFESSOR SMITH, MR. WALLACE.

CHEMISTRY 7. Same as 6. Intended for students pursuing chemistry as a major subject. Prerequisite, Chemistry 4. One hour lecture and twelve hours laboratory. Both terms. PROFESSOR SMITH, MR. WALLACE.

CHEMISTRY 8. Same as 7. Intended for Chemical Engineering students. Prerequisite, Chemistry 5. One hour lecture and nine hours laboratory. Both terms. PROFESSOR SMITH, MR. WALLACE.

CHEMISTRY 9. *Organic Chemistry* (Elementary Course).—Illustrated lecture course, preliminary to 10. It is intended to give the student a general knowledge of the carbon compounds. Special attention is paid to practical application. Must be preceded or accompanied by Chemistry 7 or 8. Two hours. Both terms. PROFESSOR TAGGART.

CHEMISTRY 10. *Organic Chemistry* (Advanced).—Must be preceded by 9. Three hours. Both terms. PROFESSOR TAGGART.

CHEMISTRY 11. *Organic Chemistry* (Minor Course).—Lectures, recitations and laboratory work. Prerequisite, Chemistry 3. One hour recitation and four hours laboratory. Both terms. Three units. PROFESSOR TAGGART.

CHEMISTRY 12. *Practical Organic Chemistry*.—Preparation and study of a series of typical organic compounds, together with their qualitative and ultimate analysis. Must be accompanied by Chemistry 10. Ten hours. Both terms. PROFESSOR TAGGART.

CHEMISTRY 13. *Applied Chemistry*.—Lectures upon subjects pertaining both to Inorganic and Organic Chemistry, supplemented by regular excursions to chemical plants. Prerequisite, Chemistry 9 or 11. Two hours. Both terms. PROFESSOR SHINN.

CHEMISTRY 14. *Analysis of Foods and Technical Products*.—Analysis of milk, butter, bread, honey, coffee, chocolate, sugar (with the use of the polariscope), pepper, water, soaps, lubricating oils, paints, tanning materials, etc., etc. Lectures and recitations, with practical exercises. Prerequisites, Chemistry 6 and 9. Two hours lecture and six hours laboratory. Second term. PROFESSOR TAGGART.

CHEMISTRY 15. *Theoretical Chemistry*.—Lectures and recitations. Prerequisites, Chemistry 6 and 9. One hour. Both terms. PROFESSOR SMITH.

CHEMISTRY 16. *Electro-Chemistry*.—Lectures, setting forth the theoretical side of the subject, with applications of the electric current to analysis, and to the preparation of chemical products. Prerequisite, Chemistry 6. One hour. Both terms. PROFESSOR SMITH, ASSISTANT PROFESSOR LUKENS.

CHEMISTRY 17. *Assaying*.—Gold, silver, lead, iron, copper and coal assays. Lectures and laboratory. Must be accompanied or preceded by Chemistry 6. One hour lecture and three hours laboratory. Both terms. PROFESSOR SHINN.

CHEMISTRY 18. Same as 17 intended for Chemical Engineering students. One hour lecture and three hours laboratory. Second term. PROFESSOR SHINN.

CHEMISTRY 19. *Practical Electro-Chemistry*.—Laboratory for Chemists. Must be accompanied by Chemistry 16. Eight hours. First term. PROFESSOR SMITH, ASSISTANT PROFESSOR LUKENS.

CHEMISTRY 20. *Practical Electro-Chemistry*.—Laboratory for Chemical Engineers. Must be accompanied by Chemistry 16. Six hours. Second term. PROFESSOR SMITH, ASSISTANT PROFESSOR LUKENS.

CHEMISTRY 21. *Physical Chemistry*.—Lectures, one hour a week, dealing with relations between theories and facts, as well as with the properties, and phase and energy relations of matter. Laboratory, three hours a week, measurement of densities of gases and liquids, boiling points, freezing points, practice and spectrometer, polarimeter, refractometer and various physico-chemical apparatus. Prerequisite, Chemistry 7. One hour lecture and three hours laboratory. Both terms. DR. HARNED.

CHEMISTRY 22. *Inorganic Technical Analysis*.—Analysis of furnace gas, cement, fertilizers, bleaching materials, etc. Prerequisite, Chemistry 7. One hour lecture and twelve hours laboratory. Second term. PROFESSOR SHINN.

CHEMISTRY 23. Same as 22 for Chemical Engineers. Prerequisite, Chemistry 8. One hour lecture and nine hours laboratory. Second term. PROFESSOR SHINN.

CIVIL ENGINEERING.

CIVIL ENGINEERING 1. *Descriptive Geometry*.—Elementary plane problems. Problems of the point, line and plane; single-curved, double-curved and warped surface. Shade and shadows. Isometric drawing and perspective. Three hours. Both terms. ASSISTANT PROFESSOR SLAGLE.

CIVIL ENGINEERING 2. *Lettering*.—Freehand lettering. Two hours. First term. ASSISTANT PROFESSOR SLAGLE.

CIVIL ENGINEERING 3. *Freehand Drawing*.—Lines and figures on plane surfaces; objects in freehand perspective. One hour. Both terms. ASSISTANT PROFESSOR SLAGLE.

CIVIL ENGINEERING 4. *Mechanical Drawing*.—Drafting instruments and operations; elementary projection; line shading; coloring; graining; representation of earthwork and masonry. Two hours. Both terms. ASSISTANT PROFESSOR SLAGLE.

CIVIL ENGINEERING 5. *Mechanical Drawing*.—Drawings based on sketches and measurements of objects. Prerequisite, Civil Engineering 4. Three hours. Both terms. ASSISTANT PROFESSOR SLAGLE.

CIVIL ENGINEERING 6. *Topographical Drawing*.—Conventional methods of representation in ink and in color. Elementary exercises. Three hours. Second term. ASSISTANT PROFESSOR SLAGLE.

CIVIL ENGINEERING 7. *Map Drawing*.—Map of hydrographic and topographic survey made during the previous summer. Prerequisite, Civil Engineering 11. Two hours. First term. ASSISTANT PROFESSOR SLAGLE.

CIVIL ENGINEERING 10. *Surveying: Theory*.—Theory relating to the use and adjustments of the instruments; theory of topographic, hydrographic, mining and city surveying. Three hours. First term. PROFESSOR INGRAM, ASSISTANT PROFESSOR GRANDLIENARD.

CIVIL ENGINEERING 11. *Surveying: Practice*.—Practice in the adjustment and use of field and office instruments, including a special farm survey which is made during the first term. Concurrent with Civil Engineering 10. Three hours, first term. Three hours, half of second term. PROFESSOR INGRAM, ASSISTANT PROFESSOR GRANDLIENARD.

CIVIL ENGINEERING 12. *Railroad Surveying: Theory*.—Simple, compound, reversed and transition curves. Turnouts and switches. Theory of the computation of earthwork. Prerequisites, Civil Engineering 10, Civil Engineering 11. Three hours. Second term. PROFESSOR INGRAM, ASSISTANT PROFESSOR GRANDLIENARD.

CIVIL ENGINEERING 13. *Railroad Surveying: Practice*.—Practice in staking out curves, cross-sectioning, setting of slope stakes, etc. Prerequisites, Civil Engineering 10, Civil Engineering 11. Concurrent with Civil Engineering 12. Three hours. Half of second term. PROFESSOR INGRAM, ASSISTANT PROFESSOR GRANDLIENARD.

CIVIL ENGINEERING 14. *Summer Surveying Practice*.—At the end of the second term two weeks are devoted to an extended topographic and hydrographic survey; and two weeks to field practice in laying out a short line of railroad, including reconnaissance, preliminary survey, location, determination of grades, cross-sectioning, drawing of the map and profile. Prerequisites, Civil Engineering 11, Civil Engineering 13. PROFESSOR INGRAM, ASSISTANT PROFESSOR GRANDLIENARD.

CIVIL ENGINEERING 15. *Railroad Construction and Maintenance*.—Maintenance of railway track and structures. Rolling stock, signaling, etc. Prerequisites, Civil Engineering 12, Civil Engineering 13. Two hours. First term. PROFESSOR INGRAM, ASSISTANT PROFESSOR GRANDLIENARD.

CIVIL ENGINEERING 16. *Railroad Office Work*.—Computation and distribution of earthwork. Paper location of a line of railroad; construction of the profile; estimates of quantities and cost. Prerequisites, Civil Engineering 12, Civil Engineering 13. Concurrent with Civil Engineering 15. Two hours. First term. PROFESSOR INGRAM, ASSISTANT PROFESSOR GRANDLIENARD.

CIVIL ENGINEERING 17. *Railroad Economics*.—General theory of the inception and completion of railroad projects; probable volume of traffic and its probable growth; effect of details of alignment on operating expenses and revenue. Prerequisite, Civil Engineering 15. Two hours. First term. PROFESSOR INGRAM, ASSISTANT PROFESSOR GRANDLIENARD.

CIVIL ENGINEERING 18. *Railroad Design*.—Elements of the design of yards, terminals and sidings; slip-switches, crossings and track details. Prerequisites, Civil Engineering 15, Civil Engineering 16. Two hours. First term. PROFESSOR INGRAM, ASSISTANT PROFESSOR GRANDLIENARD.

CIVIL ENGINEERING 19. *Geodesy: Theory*.—Study of the instruments and field methods used in geodetic surveying and theory of adjustment of observations. Prerequisites, Civil Engineering 10, Civil Engineering 11. Two hours. Second term. PROFESSOR INGRAM, ASSISTANT PROFESSOR GRANDLIENARD.

CIVIL ENGINEERING 20. *Geodesy: Practice*.—Practice in the use of instruments of precision for the measurement of base-lines, angles, and differences of elevation. Prerequisites, Civil Engineering 10, Civil Engineering 11. Concurrent with Civil Engineering 19. Three hours. Second term. PROFESSOR INGRAM, ASSISTANT PROFESSOR GRANDLIENARD.

CIVIL ENGINEERING 25. *Hydromechanics*.—Energy of fluids. Flow by orifices, tubes and weirs. Flow in pipes, conduits, canals and natural streams. Current meters. Hydraulic motors. Measurement of water-power. Prerequisite, Mathematics 40. Four hours. First term. PROFESSOR EASBY, ASSISTANT PROFESSOR PARDOE.

CIVIL ENGINEERING 26. *Hydraulic Testing*.—Tests for determining the discharge of water through orifices and pipes and over weirs; and of the efficiency of different types of hydraulic motors. Concurrent with or following Civil Engineering 25. Three hours. For half of the class each term. PROFESSOR EASBY, ASSISTANT PROFESSOR PARDOE.

CIVIL ENGINEERING 27. *Water-Supplies*.—Consumption by municipalities. Yields from various sources. Examination of water-supplies. Impounding reservoirs. Purification. Distribution. Prerequisites, Civil Engineering 25, Mathematics 40. Two hours. Second term. PROFESSOR EASBY, ASSISTANT PROFESSOR PARDOE.

CIVIL ENGINEERING 28. *Sanitary Engineering*.—Sewers and drains. Construction and ventilation. Disposal of sewage. Prescribed also for students in the course of Public Hygiene. Prerequisite (for Civil Engineering students), Civil Engineering 25. Two hours. Second term. PROFESSOR EASBY, ASSISTANT PROFESSOR PARDOE.

CIVIL ENGINEERING 29. *Hydraulic Works Design*.—The designing of water and sewerage works. Prerequisites, Civil Engineering 25, Civil Engineering 27, Civil Engineering 28. Five hours. First term. PROFESSOR EASBY, ASSISTANT PROFESSOR PARDOE.

CIVIL ENGINEERING 30. *Roads and Pavements*.—Construction, maintenance and cost. Consideration of the relative merits of the various types. Two hours. First term. PROFESSOR EASBY, ASSISTANT PROFESSOR PARDOE.

CIVIL ENGINEERING 35. *Materials of Construction*.—Physical characteristics of the materials of construction, and the conditions by which these are influenced. Prerequisite, Civil Engineering 40. Two hours. Second term. PROFESSOR MARBURG, PROFESSOR BERRY.

CIVIL ENGINEERING 36. *Materials Testing*.—Tests for determining the physical properties of steel, wrought and cast iron, timber, brick, etc. Concurrent with or following Civil Engineering 35, Civil Engineering 40. For half of the class each term. PROFESSOR BERRY.

CIVIL ENGINEERING 37. *Cement Testing*.—Tests for determining the physical properties of cement, sand, mortar and plain and reinforced concrete. Three hours. First term. PROFESSOR BERRY.

CIVIL ENGINEERING 40. *Mechanics of Materials*.—The resistance and elasticity of materials. Theory of flexure applied to beams and columns. Torsion. Effect of impact. Resilience, fatigue, etc. Prerequisite, Mathematics 40. Five hours. First term. PROFESSOR MARBURG.

CIVIL ENGINEERING 41. *Graphic Statics*.—Graphic methods applied to the determination of stresses, bending moments, shears, etc. Concurrent with Civil Engineering 42. One hour. Second term. PROFESSOR MARBURG.

CIVIL ENGINEERING 42. *Framed Structures*.—Determination of stresses by analytic methods. Relative merits of different types of bridge and roof trusses. Skeleton construction of buildings, viaducts, turn-tables, stand-pipes, etc. Details of construction. Prerequisite, Civil Engineering 40. Five hours. Second term. PROFESSOR MARBURG.

CIVIL ENGINEERING 43. *Framed Structures*.—Stresses in cantilever, arch, swing and suspension bridges. Prerequisite, Civil Engineering 42. Three hours. First term. PROFESSOR MARBURG.

CIVIL ENGINEERING 44. *Bridge Design*.—Complete design of a plate-girder bridge. Computations and detail drawings. Concurrent with Civil Engineering 42. Three hours. Second term. PROFESSOR MARBURG.

CIVIL ENGINEERING 45. *Bridge Design*.—Complete design of a railroad bridge. Pratt truss. Computations and detail drawings. Prerequisite, Civil Engineering 44. Four hours. Both terms. PROFESSOR MARBURG.

CIVIL ENGINEERING 46. *Masonry*.—Foundations, dams, retaining walls, piers, abutments, culverts, arches, and concrete constructions. Elements of stereotomy. Three hours. First term. ASSISTANT PROFESSOR SLAGLE.

CIVIL ENGINEERING 47. *Masonry Design*.—General design of a variety of masonry structures. Prerequisite, Civil Engineering 46. Three hours. Second term. ASSISTANT PROFESSOR SLAGLE.

CIVIL ENGINEERING 48. *Reinforced Concrete*.—The theory and practice of reinforced concrete applied to the design of beams, columns, arches and other forms of construction. Four hours. First term. PROFESSOR BERRY.

CIVIL ENGINEERING 50. *Engineering Computations*. — Short methods and checks in arithmetical computations. Use of slide rule. One hour. First term. PROFESSOR INGRAM, ASSISTANT PROFESSOR GRANDLIENARD.

SPECIAL LECTURES 1. Monthly lectures by visiting engineers.

CIVIL ENGINEERING 52. *Summer Memoir*.—A memoir of not less than sixteen hundred words, prepared during the summer vacation following the Junior year, descriptive of some engineering work or manufacturing plant, based on direct personal inquiries and observations.

CIVIL ENGINEERING 53. *Thesis*.—Thesis on a professional subject. Six hours. Second term. PROFESSORS MARBURG, EASBY, INGRAM and BERRY, ASSISTANT PROFESSORS SLAGLE, GRANDLIENARD and PARDOE.

CIVIL ENGINEERING 60. *Descriptive Geometry*.—Elementary plane problems. Problems of the point, line and plane; single-curved; double-curved and warped surfaces and isometric drawing. Prescribed for students in Mechanical and Electrical Engineering. Three hours. Both terms. ASSISTANT PROFESSOR SLAGLE.

CIVIL ENGINEERING 61. *Surveying: Theory*.—Short course for mechanical and Electrical Engineering students only. Three hours. Half of second term. PROFESSOR INGRAM, ASSISTANT PROFESSOR GRANDLIENARD.

CIVIL ENGINEERING 62. *Surveying: Practice*.—Short course for Mechanical and Electrical Engineering students only. Prerequisite, Civil Engineering 61. Three hours. Half of second term. PROFESSOR INGRAM, ASSISTANT PROFESSOR GRANDLIENARD.

CIVIL ENGINEERING 63. *Municipal Water Supplies*.—The quantity of water required; yield of sources; water purification; general features of water works design and construction. Prescribed for students in the course in Public Hygiene. Two hours. Second term. PROFESSOR EASBY.

CIVIL ENGINEERING 64. *Disposal of Municipal Refuse and Street Cleaning*.—Classification and description of wastes. Methods of collecting, incinerating and reducing wastes. Methods of street cleaning. Prescribed for students in the course in Public Hygiene. One hour. Second term. PROFESSOR EASBY.

COMMERCE AND TRANSPORTATION.

COMMERCE AND TRANSPORTATION I. *The Business of American Commerce*.—Part I: Markets and marketing methods of (1) manufactures and minerals; (2) farm products. Prices. Transportation facilities and costs. Part II: Organization of the foreign trade. Foreign markets. Prerequisites, Geography and Industry 1 or 2 or 3, Sophomore year.

ELECTRICAL ENGINEERING.

ELECTRICAL ENGINEERING 1. *Principles of Electrical Engineering*.—Principles of electricity and magnetism; electric and magnetic circuits; direct current generators and motors; storage batteries. Five hours. First term. Junior year. Requisite, Physics 18. PROFESSOR CLEWELL, DR. TRUEBLOOD, MR. DALY.

ELECTRICAL ENGINEERING 2. *Electrical Measurements*.—The principles, construction, and use of instruments for the measurement of resistance, current, electromotive force, capacity, inductance, power, and energy; methods for measuring these quantities; methods of calibrating commercial instruments; iron testing. Two hours. Both terms. Junior year. Requisite, concurrent with Electrical Engineering 1. DR. TRUEBLOOD, MR. W. F. JOHNSON.

ELECTRICAL ENGINEERING 3. *Electrical Laboratory*.—A laboratory course covering the same topics as Electrical Engineering 1, 2 and 4. Four hours, first term; seven hours, second term. Junior year. Requisite, concurrent with Electrical Engineering 1. PROFESSOR CLEWELL, DR. TRUEBLOOD and Instructors.

ELECTRICAL ENGINEERING 4. *Alternating Currents*.—Definitions of terms; instantaneous values and effective values; phase relations; power factor; impedance and reactance; calculations of circuits; analysis of complex waves; polyphase circuits; building up and decay

of current and voltage in circuits. Four hours. Second term. Junior year. Requisites, Electrical Engineering 1 and 2, Mathematics 43. PROFESSOR PENDER, MR. STRAW.

ELECTRICAL ENGINEERING 11. *Illumination*.—Principles of illuminating engineering; photometry; practical problems in the lighting of factories and offices. Two hours. First term. Senior year. Requisites, Electrical Engineering 1 and 4. PROFESSOR CLEWELL, MR. MARTIN.

ELECTRICAL ENGINEERING 12. *Seminar*.—Each Senior student is assigned one or more topics of timely interest, on each of which he prepares a paper of some 2500 words, articles in the technical journals being used as a basis. He then presents extemporaneously a synopsis of this paper before the Senior class and Instructing Staff. One hour. Both terms. Senior year. Requisites, Electrical Engineering 1 and 4. PROFESSOR PENDER and Staff.

ELECTRICAL ENGINEERING 13. *Electric Power Plants*.—Location of central station and substations; choice and arrangement of prime movers and auxiliary apparatus for steam-electric and hydroelectric plants; plans and diagrams for typical layouts; preliminary cost estimates; operating and fixed charges. Three hours. Second term. Senior year. Requisite, concurrent with Electrical Engineering 17. MR. FAWCETT.

ELECTRICAL ENGINEERING 14. *Electric Railways*.—Forces acting on a train; speed-time curves; energy requirements; motor capacity; train diagrams; distribution lines; power-house requirements; systems of control; alternating versus direct current; electricity versus steam; preliminary cost estimates. Three hours. Second term. Senior year. Requisite, concurrent with Electrical Engineering 17. PROFESSOR PENDER, MR. KEGERREIS.

ELECTRICAL ENGINEERING 15. *Motor Applications*.—Analysis of the speed-torque characteristics of mechanical machinery to which electrical drive is applicable; selection of type of motor applicable thereto; types of motor control; costs. Two hours. Second term. Senior year. Requisites, Electrical Engineering 1 and 4 and concurrent with Electrical Engineering 17. PROFESSOR CLEWELL, MR. FINLEY.

ELECTRICAL ENGINEERING 16. *Distribution and Transmission*.—Systems in use; general requirements; calculation of direct and alternating current lines; mechanical design; poles, towers, insulators; erection; control and protection; preliminary cost estimates. Two hours. First term. Senior year. Requisites, Electrical Engineering 1 and 4. PROFESSOR PENDER, MR. C. H. JOHNSON.

ELECTRICAL ENGINEERING 17. *Alternating Current Machinery*.—Principles involved in the design, construction, operation, and testing of alternators, synchronous motors, transformers, induction

motors, and single-phase commutator motors. Four hours. Both terms. Senior year. Requisites, Electrical Engineering 1 and 2. PROFESSOR PENDER, MR. STRAW.

ELECTRICAL ENGINEERING 18. *Electric Machinery Laboratory*.—Commercial methods of testing electric machinery and apparatus; special tests illustrative of the principles covered in Electrical Engineering 17; photometric and illumination tests. Seven hours, first term; four hours, second term. Senior year. Requisite, concurrent with Electrical Engineering 17. PROFESSOR CLEWELL and Instructors.

ELECTRICAL ENGINEERING 19. *Electrical Thesis*.—Solution of special problems in electrical engineering. Nine hours. Second term. Senior year. Requisite, in last year only. PROFESSOR PENDER and Staff.

ELECTRICAL ENGINEERING 20. *Telegraphy and Telephony*.—General layout of telephone systems; transmitters and receivers; transmission of high frequency currents over wires; submarine telegraphy; central office equipment; estimates and reports. Three hours. Second term. Requisites, Electrical Engineering 1 and 4. DR. TRUEBLOOD, MR. DALY.

ELECTRICAL ENGINEERING 31. *Elements of Electrical Engineering*.—For students in Mechanical and Chemical Engineering. Fundamental principles of direct current and alternating current circuits and instruments. A brief course covering the same topics as Electrical Engineering 1, 2 and 4. Four hours. First term. Junior year. Requisite, Physics 18. PROFESSOR CLEWELL and Instructors.

ELECTRICAL ENGINEERING 32. *Electric Laboratory*.—For students in Mechanical and Chemical Engineering. A laboratory course covering the same topics as Electrical Engineering 31 and 33 (first part), but somewhat shorter. Three hours. Both terms. Junior year. Requisite, concurrent with Electrical Engineering 31. PROFESSOR CLEWELL and Instructors.

ELECTRICAL ENGINEERING 33. *Electric Machinery*.—For students in Mechanical and Chemical Engineering. The operating characteristics of direct and alternating current machinery. A brief course covering the same topics as Electrical Engineering 17. Three hours. Second term. Junior year. Requisite, Electrical Engineering 31. PROFESSOR CLEWELL and Instructors.

ELECTRICAL ENGINEERING 41. *Industrial Applications of Electricity*.—For students in Mechanical and Chemical Engineering. Covers approximately the same ground as Electrical Engineering 11 and 15. Three hours. First term. Senior year. Requisites, Electrical Engineering 31 and 33. PROFESSOR CLEWELL and Instructors.

ELECTRICAL ENGINEERING 42. *Electric Machinery Laboratory*.—For students in Mechanical and Chemical Engineering. A laboratory course covering the same topics as Electrical Engineering 33 (second part) and 41. Three hours. First term. Senior year. Requisites, Electrical Engineering 31 and 33. PROFESSOR CLEWELL and Instructors.

ELECTRICAL ENGINEERING 51. *Applied Electricity*.—For students in Civil Engineering. A short course dealing with the operating characteristics of generators and motors, with special reference to the application of the latter in civil engineering work. Three hours. First term. Senior year. Requisite, Physics 18. PROFESSOR CLEWELL and Instructors.

ENGLISH.

Courses 1, 3, 30, 40, and 42 are prescribed for all students, except Mechanical, Electrical, and Civil Engineers, as the six required units in English. In place of these, students in Mechanical, Electrical, and Civil Engineering will take English 2, 4, 41, and 42.

Three objects are contemplated in the arrangement of the undergraduate work in English: (1) proficiency in writing, with some practice in speaking and debate; (2) a study of the nature and history of the language; (3) a general acquaintance with English Literature.

COMPOSITION.

ENGLISH 1. *Composition*.—Weekly themes on assigned subjects. Prerequisites, English A and B (admission). Two hours. Both terms. Two units. ASSISTANT PROFESSORS O'BOLGER and SHELLY, MR. HARBESON, MR. MCCLELLAND, MR. MENDENHALL, MR. HESSLER, MR. FOUST, MR. DOLMAN, DR. KITCHEN, MR. BAUGH, MR. McDONALD, MR. SCHMITT.

ENGLISH 2. The general method of English 1 is followed in this course likewise, with special attention to the requirements of engineering students. Prerequisites, English A and B (admission). Two hours. Both terms. Two units. Instructors as for English 1.

ENGLISH 3. *Composition*.—Weekly themes; descriptive, narrative, expository. Prerequisite, English 1. One hour. Both terms. One unit. ASSISTANT PROFESSORS O'BOLGER and SHELLY, MR. HARBESON, MR. MCCLELLAND, MR. MENDENHALL, MR. HESSLER, MR. FOUST, MR. DOLMAN, DR. KITCHEN, MR. BAUGH, MR. McDONALD, MR. SCHMITT.

ENGLISH 4. *Composition*.—Weekly themes as in course 3, except that the course extends over one term only. For engineering students only. Prerequisite, English 2. One hour. First term. One half unit. Instructors as for English 3.

ENGLISH LANGUAGE.

ENGLISH 30. *English Language*.—An historical treatment of the English language. Prerequisites, English A and B (admission). Two hours. Second term. One unit. PROFESSOR C. G. CHILD, PROFESSOR QUINN, ASSISTANT PROFESSORS O'BOLGER and SHELLY, MR. MENDENHALL, MR. FOUST, MR. BAUGH.

LITERATURE.

ENGLISH 40. *History of English Literature*.—From Anglo-Saxon times to the present day. Prerequisites, English A and B (admission). Two hours. First term. One unit. PROFESSOR PENNIMAN, PROFESSOR C. G. CHILD, PROFESSOR WEYGANDT, ASSISTANT PROFESSOR SHELLY, MR. HARBESON, MR. MCCLELLAND, MR. MENDENHALL, MR. FOUST, MR. DOLMAN, MR. BAUGH.

ENGLISH 41. *History of Modern English Literature*.—From Shakespeare to the present day. Prerequisites, English A and B (admission). English 41 is not open to students in the College or the Wharton School. Instructors as for English 40.

ENGLISH 41 F. *History of English Literature*.—For foreign students. A course specially designed to aid foreign students in making an acquaintance with English literature. Two hours. First term. One unit. ASSISTANT PROFESSOR O'BOLGER.

ENGLISH 42. *Nineteenth Century Novelists*.—Prerequisites, English A and B (admission). Two hours. First term. One unit. PROFESSOR PENNIMAN, PROFESSOR QUINN, PROFESSOR WEYGANDT, MR. HARBESON, MR. MCCLELLAND, DR. KITCHEN.

ENGLISH 42 F. *Nineteenth Century Novelists*.—For foreign students. A course intended to acquaint foreign students with recent and contemporary English writers. Two hours. Second term. One unit. ASSISTANT PROFESSOR O'BOLGER.

ENGLISH 43. *English Essayists*.—Prerequisites, English 1, 30, 40. Two hours. Second term. One unit. PROFESSOR SCHELLING, PROFESSOR PENNIMAN, ASSISTANT PROFESSOR SHELLY.

ENGLISH 51. *Middle English Literature to Chaucer*.—Prerequisites, English 1, 30, 40. Two hours. Second term. One unit. Omitted in 1914-15. PROFESSOR C. G. CHILD.

ENGLISH 61. *Readings in Shakespeare*.—Prerequisites, the six required units. Two hours. One unit. PROFESSOR SCHELLING.

ENGLISH 62. *Elizabethan Dramatists*.—Prerequisites, English 1, 30, 40. Two hours. First term. One unit. PROFESSOR SCHELLING.

ENGLISH 70. *Seventeenth and Eighteenth Century Literature*.—Prerequisites, English 1, 30, 40. Two hours. First term. One unit. PROFESSOR SCHELLING, PROFESSOR PENNIMAN.

ENGLISH 71. *The English Bible*.—Prerequisites, English 1, 30, 40. Two hours. First term. One unit. PROFESSOR PENNIMAN.

ENGLISH 90. *Nineteenth Century Poets*.—Prerequisites, English 1, 30, 40. Two hours. Second term. One unit. PROFESSOR SCHELLING, PROFESSOR PENNIMAN, MR. McCLELLAND.

ENGLISH 91. *Nineteenth Century Drama*.—Prerequisites, English 1, 30, 40. Two hours. First term. One unit. PROFESSOR WEYGANDT.

ENGLISH 94. *Contemporary Novel*.—Prerequisites, English 1, 30, 40. Two hours. Second term. One unit. PROFESSOR WEYGANDT.

ENGLISH 96. *American Literature to the Civil War*.—Prerequisites, English 1, 30, 40. Two hours. First term. One unit. PROFESSOR QUINN.

ENGLISH 97. *American Literature from the Civil War*.—Prerequisites, English 1, 30, 40. Two hours. Second term. One unit. PROFESSOR QUINN.

FRENCH.

FRENCH 1. *Elementary French*.—Elementary Grammar and Reading. François, *Beginner's French*; Super, *French Reader*; Labiche and Martin, *Le voyage de M. Perrichon*; Mérimée, *Colomba*; Labiche, *La Grammaire*. Four hours. Both terms. Four units. May not be taken as required work in language. MR. TROMBLY, MR. LAURIE, MR. DOUGLASS, MR. DI SANTO.

FRENCH 2. *Intermediate French*.—Daudet, *Tartarin de Tarascon*; Mérimée, *Contes*; Maupassant, *Contes*; A. de Musset, *Comédies*; Augier, *Le gendre de M. Poirier*; Rostand, *Les Romanesques*; P. Loti, *Ramuntcho*. Prerequisite, French A (admission). May not be taken for credit if French B has been offered for admission. Two hours. Both terms. Two units. PROFESSOR CRAWFORD, MR. TROMBLY, MR. DOUGLASS, MR. DI SANTO.

FRENCH 3. *Intermediate French Grammar*.—Written and oral exercises. Prerequisite, French A (admission). May not be taken for credit if French B has been offered for admission. One hour. Both terms. One unit. PROFESSOR CRAWFORD, MR. TROMBLY, MR. DOUGLASS, MR. DI SANTO.

FRENCH 4. *Outline of French Literature*.—Selections from the works of the most important writers from the seventeenth century to the present time will be read and discussed. This course is intended as an introduction to a more intensive study of special periods. Prerequisite, French 2, or admission B. Two hours. Two terms. Two units. ASSISTANT PROFESSOR SHANKS, MR. TROMBLY.

FRENCH 5. *Advanced French Grammar*.—Prose Composition. Conversation. Prerequisite, French 3, or admission B. One hour. Both terms. One unit. ASSISTANT PROFESSOR SHANKS.

FRENCH 6. *Scientific French Reading*.—Dyke, *Scientific French Reader*; Bowen, *Scientific French Reader*. For Sophomore en-

gineers. Prerequisite, French 2. Two hours. Both terms. Two units. DR. VAUGHN.

FRENCH 7. *Scientific French Grammar*.—Prose Composition. Conversation. For Sophomore engineers. Prerequisite, French 3. One hour. Both terms. One unit. DR. VAUGHN.

FRENCH 8. *Scientific French*.—Bowen, *Scientific French Reader*; Luquiens, *Popular Science*. Prerequisites, French 2 and 3. Two hours. Both terms. Two units. MR. DOUGLASS.

FRENCH 9. *Advanced Scientific French*.—*La Revue Scientifique*. Prerequisite, French 4 or 6 or 8. Two hours. Both terms. Two units. MR. DOUGLASS.

GEOLOGY, MINERALOGY, METALLURGY.

GEOLOGY.

GEOLOGY 3. *General Geology*.—Dynamic and structural geology, Geomorphology and historical geology. It is desirable that Mineralogy 1 or 5 precede or accompany Geology 3. Two hours. Both terms. Two units. PROFESSOR A. P. BROWN.

GEOLOGY 9. *Inorganic Geology*.—Prerequisites, Chemistry 1, Mineralogy 6. For Civil Engineering students only. Two hours. Second term. One unit. ASSISTANT PROFESSOR EHRENFELD.

MINERALOGY.

MINERALOGY 1. *Mineralogy*.—Crystallography, native elements, sulphides, chlorides, fluorides, oxides. It is desirable that Chemistry 1 precede or accompany Mineralogy 1. Two hours. Both terms. Two units. PROFESSOR A. P. BROWN.

MINERALOGY 2. *Mineralogy*.—Carbonates, silicates, sulphates, phosphates, etc. Prerequisite, Mineralogy 1. Two hours. Both terms. Two units. PROFESSOR A. P. BROWN.

MINERALOGY 3. *Determinative Mineralogy*.—Blowpipe analysis. Determination of minerals by pyrognostic and physical properties. Prerequisites, Mineralogy 1 or 5 and Chemistry 1. It is desirable that this course be preceded or accompanied by Chemistry 2. Two hours. Both terms. One unit. PROFESSOR A. P. BROWN, DR. TRAVIS.

MINERALOGY 6. *Mineralogy*.—Short course in Mineralogy. Prerequisites, Chemistry 1 and 2. Open to Civil Engineering students only. Two hours. First term. One unit. DR. TRAVIS.

METALLURGY.

METALLURGY 1. *Theory of Metallurgical Processes*.—The dressing and metallurgical treatment of ores. Prerequisites, Chemistry 1 and 2. May not be taken as group work in Geology or Mineralogy. Two hours. Second term. One unit. PROFESSOR A. P. BROWN, ASSISTANT PROFESSOR EHRENFELD, DR. TRAVIS.

GERMAN.

GERMAN 1. *Elementary German*.—Grammar and reading. May not be taken as required work in language. Four hours. Both terms. Four units. MR. H. D. LEARNED.

GERMAN 2. *Reading of Literary Prose and Eighteenth Century Drama*.—Prerequisite, German A (admission) or an approximate equivalent. May not be taken for credit if German B has been offered for admission. Two hours. Both terms. Two units. PROFESSOR WESSELHOEFT, DR. FOGEL, DR. JOHNSON, MR. H. D. LEARNED, MR. MARQUARDT, MR. METZENTHIN, MR. SCHOLZ, MR. KAMMAN.

GERMAN 3. *Grammar and Composition*.—Written and oral exercises. Prerequisite, German A (admission) or an approximate equivalent. May not be taken for credit if German B has been offered for admission. One hour. Both terms. One unit. PROFESSOR WESSELHOEFT, DR. JOHNSON, MR. H. D. LEARNED, MR. MARQUARDT, MR. SCHOLZ, MR. KAMMAN.

GERMAN 4. *Scientific Prose for Freshman Engineers*.—Prerequisite A (admission), or an approximate equivalent. One hour. Both terms. One unit. DR. JOHNSON, MR. H. D. LEARNED, MR. MARQUARDT, MR. METZENTHIN, MR. SCHOLZ.

GERMAN 5. *Lectures on Schiller's Life and Works, and the Literary Movements of His Time*.—Reading of selected texts. Prerequisites, German 2 and 3. Two hours. First term. One unit. PROFESSOR M. D. LEARNED, PROFESSOR SHUMWAY, PROFESSOR WESSELHOEFT, DR. FOGEL, MR. H. D. LEARNED, MR. METZENTHIN.

GERMAN 6. *Reading of Selected Historical Prose*.—Prerequisites, German 2 and 3. Two hours. Second term. One unit. PROFESSOR SHUMWAY, PROFESSOR WESSELHOEFT, DR. FOGEL, MR. H. D. LEARNED.

GERMAN 7. *German Composition and Conversation*.—Prerequisite, German 3. One hour. Both terms. One unit. PROFESSOR M. D. LEARNED, PROFESSOR WESSELHOEFT, DR. FOGEL, MR. METZENTHIN, MR. SCHOLZ.

GERMAN 8. *Intermediate Scientific German*.—Prerequisites, German 2 and 4. Two hours. Both terms. Two units. DR. FOGEL, MR. H. D. LEARNED, MR. MARQUARDT, MR. SCHOLZ, MR. KAMMAN.

GERMAN 9. *Literary German for Engineers*.—Prerequisites, German 2 and 3. One hour. Both terms. One unit. DR. FOGEL, DR. JOHNSON, MR. H. D. LEARNED, MR. MARQUARDT, MR. METZENTHIN, MR. KAMMAN.

GERMAN 10. *Scientific Reading for Chemists*.—Prerequisites, German 2 and 3. Two hours. Both terms. Two units. DR. JOHNSON.

GERMAN 11. *Advanced Scientific Reading*.—Prerequisite, German 10. Two hours. Both terms. Two units. PROFESSOR WESSELHOEFT.

HYGIENE.

HYGIENE 1. *Ventilation and Plumbing*.—Preliminary to Architecture. One hour. First term. ASSISTANT PROFESSOR BERGEY.

MATHEMATICS.

MATHEMATICS 31. *Algebra*.—For Freshmen in the course in Chemistry. Prerequisites, Mathematics A and C (admission). Four hours. First term. Two units. PROFESSOR EVANS.

MATHEMATICS 32. *Fundamental Principles of Analytic Geometry and Calculus with Application*.—For Freshmen in the course in Chemistry. Prerequisites, Mathematics D and E (admission); Mathematics 31. Four hours. Second term. Two units. PROFESSOR EVANS.

MATHEMATICS 33. *Algebra and Plane Trigonometry*.—For Freshmen in the course in Architecture. Prerequisites, Mathematics A, C, D (admission). Four hours. First term. Two units. The class is divided into several sections in charge of different instructors.

MATHEMATICS 34. *Analytic Geometry*.—For Freshmen in the course in Architecture. Prerequisite, Mathematics 33. Four hours. Second term. Two units. The class is divided into several sections in charge of different instructors.

MATHEMATICS 35. *Plane and Spherical Trigonometry*.—For Freshmen in the Engineering courses. Prerequisites, Mathematics A, C, D, E (admission). Four hours.* First term. Two units. The class is divided into several sections in charge of different instructors.

MATHEMATICS 36. *Algebra and introduction to Analytic Geometry*.—For Freshmen in the Engineering courses. Prerequisites, Mathematics A and C (admission). Four hours.* Second term. Two units. The class is divided into several sections in charge of different instructors.

MATHEMATICS 37. *Differential Calculus with Applications*.—For Sophomores in the course in Architecture. Prerequisites, Mathematics 33 and 34. Three hours. First term. One and a half units. The class is divided into several sections in charge of different instructors.

MATHEMATICS 38. *Integral Calculus with Applications*.—For Sophomores in the course in Architecture. Prerequisite, Mathe-

*Students admitted to the courses in Chemical, Civil, Electrical and Mechanical Engineering will be offered at the beginning of Freshman year an opportunity to pass an examination in the elements of plane trigonometry (see Mathematics 100). Those who pass this examination will take Mathematics 35 and 36 only three hours a week, and the content and arrangement of these courses will be appropriately modified.

matics 37. Three hours. Second term. One and a half units. The class is divided into several sections in charge of different instructors.

MATHEMATICS 39. *Analytic Geometry and Calculus, Part I.*—For Sophomores in the Engineering courses. Prerequisites, Mathematics 35 and 36. Five hours. First term. Two and a half units. The class is divided into several sections in charge of different instructors.

NOTE.—If Mathematics 39 be taken by a student in the College he will not receive full credit for the course unless he also takes and completes Mathematics 40. The credit given for Mathematics 39 alone will be only one and a half units.

MATHEMATICS 40. *Analytic Geometry and Calculus, Part II.*—For Sophomores in the Engineering courses. Prerequisites, Mathematics 36 and 39. Five hours. Second term. Two and a half units. The class is divided into several sections in charge of different instructors.

MATHEMATICS 41. *Lectures on Various Mathematical Topics.*—A series of lectures on mathematical subjects directly applicable to engineering problems. Open to Juniors and Seniors of the Towne Scientific School, attendance voluntary. A Faculty Prize* of twenty-five dollars is awarded for the best examination on this course. Prerequisite, Mathematics 40 or 38 or 32. One hour. Both terms. PROFESSOR EVANS.

MATHEMATICS 43. *Differential Equations.*—For Juniors in the course in Electrical Engineering. Prerequisite, Mathematics 40. Three hours. First term. One and a half units. PROFESSOR EVANS, DR. O'SHAUGHNESSY.

MATHEMATICS 100. An examination in the elements of plane trigonometry open to students who have been admitted to any of the four engineering courses. (See footnote to Mathematics 35 and 36.) The date for this examination in September, 1915, will be announced later.

MATHEMATICS 123. *Solid Geometry, Plane Trigonometry and College Algebra.*—For Freshmen in the School of Education. Prerequisites, Mathematics A and C. Three hours. Both terms. Three units. PROFESSOR HALLETT.

MECHANICAL ENGINEERING.

MECHANICAL ENGINEERING 1. *Elementary Drawing.*—Use of instruments. Making simple mechanical drawings from working sketches. Freehand lettering. Three hours. Both terms. Freshman year. PROFESSOR FRY.

*This prize will be discontinued after 1914-15.

MECHANICAL ENGINEERING 2. *Shop Work*.—Elements of machines, wood working and forging. Collateral reading and monthly examinations. Six hours. Both terms. Freshman year. PROFESSOR MORRIS.

MECHANICAL ENGINEERING 3. *Shop Work*.—Short course for Chemical Engineering students only. Three hours. Both terms. Freshman year. PROFESSOR MORRIS.

MECHANICAL ENGINEERING 11. *Mechanical Drawing and Sketching*.—Continuation of Mechanical Engineering 1. Sectioning, tinting and tracing detail drawings made from sketches. Blue printing. Machine sketching. Three hours. Both terms. Sophomore year. Requisites, Civil Engineering 1, Mechanical Engineering 1. PROFESSOR FRY.

MECHANICAL ENGINEERING 12. *Advanced Shop Work*.—Pattern making. Use of machine tools. Principles of foundry practice. Laying out work. Six hours, first term; three hours, second term. Sophomore year. Requisites, Civil Engineering 1, Mechanical Engineering 1, 2. PROFESSOR MORRIS.

MECHANICAL ENGINEERING 13. *Advanced Shop Work*.—Short course for Chemical Engineering students only. Three hours. Both terms. Sophomore year. Requisites, Mechanical Engineering 1, 3. PROFESSOR MORRIS.

MECHANICAL ENGINEERING 14. *Elements of Engineering*.—Nomenclature of steam machinery. General principles of the construction of machines. Power measurement. Two hours. First term. Sophomore year. Requisites, Mechanical Engineering 1, Mechanical Engineering 2 or 3. PROFESSOR STANFORD.

MECHANICAL ENGINEERING 15. *Kinematics*.—Laws of motion. Combinations of pure mechanism. Pulleys and belts. Trains of gearing and forms of teeth of wheels. Link work, epicyclic trains, etc. Three hours. Second term. Sophomore year. Requisite, Mechanical Engineering 14. MR. CROFOOT.

MECHANICAL ENGINEERING 21. *Working Drawings*.—Making complete tracings of assembly drawing and details from sketches. Three hours. First term. Junior year. Requisites, Mechanical Engineering 11, 12. PROFESSOR FRY.

MECHANICAL ENGINEERING 22. *Mechanics of Materials*.—Application of the principles of statics to rigid bodies. Elasticity and strength of materials. Forms of uniform strength. Design of beams, columns and shafts. Combined and repeated stresses. Four hours. First term. Junior year. Requisites, Mathematics 40, Physics 16, 17, 20. MR. CROFOOT.

MECHANICAL ENGINEERING 23. *Hydraulics*.—Transmission of pressures. Determining centers and amount of pressure. Depth of flotation and stability. Flow through orifices, over weirs, through

tubes, pipes and conduits. Water meters and the measurement of water power. Two hours. First term. Junior year. Requisites, Mathematics 40, Physics 16, 17, 20. MR. BARK.

MECHANICAL ENGINEERING 24. *Seminar*.—The preparation of seminar papers and data sheets, a discussion of engineering articles in the current magazines, bulletins and proceedings, and a discussion of general engineering subjects. One hour. Both terms. Junior year. Requisite, in Junior year only. PROFESSOR FERNALD.

MECHANICAL ENGINEERING 25. *Machine Design and Kinematic Design*.—Empirical design. Analytical design of machine elements. Original designs for producing definite motions with certain elements prohibited. Assembly drawings to show the construction of the parts and their relation to each other. Three hours. Both terms. Junior year. Requisites, Mechanical Engineering 11, 12, 14, 15, and concurrent with Mechanical Engineering 22. PROFESSOR FRY.

MECHANICAL ENGINEERING 26. *Mechanical Laboratory*.—Testing mechanical apparatus. Adjusting scales, indicators, counters, gauges, etc. Determining the efficiency of various machines and the values of the materials of construction. Three hours. Both terms. Junior year. Requisites, Mechanical Engineering 11, 12 or 13, 15. Mathematics 40, and concurrent with Mechanical Engineering 22, 23. PROFESSOR EHLERS.

MECHANICAL ENGINEERING 27. *Graphics*.—Principles of graphic statics and their applications to cranes, bridges, roof trusses and other framed structures. The graphics of machinery with and without friction, graphic combination of stresses in shafts, etc. Five hours. Second term. Junior year. Requisites, Mechanical Engineering 11, 15, 22, Physics 16, 17, 20. PROFESSOR STANFORD.

MECHANICAL ENGINEERING 28. *Thermodynamics*.—Mechanical theory of heat. Work done and heat expended in expansion. Cycles of perfect gases and vapors. Expansion of steam, ammonia and carbonic acid, work done and heat required. Mixtures of vapors. Three hours. Second term. Junior year. Requisites, Mechanical Engineering 14, Mathematics 40, Physics 16, 17, 20. PROFESSOR STANFORD.

MECHANICAL ENGINEERING 41. *Crane Design*.—Applications of the principles of machine design to special machinery. Four hours. First term. Senior year. Requisite, Mechanical Engineering 12 or 13, 15, 22, 27. PROFESSOR FRY.

MECHANICAL ENGINEERING 42. *Hydrodynamics*.—Theory of turbines and water wheels. Two hours. First term. Senior year. Requisite, Mechanical Engineering 23. MR. BARK.

MECHANICAL ENGINEERING 43. *Applied Thermodynamics*.—Heat engines, various efficiencies. Commercial results obtained and possibilities of development of steam, air, gas and oil engines. Re-

frigerating machines using air, ammonia, carbonic acid, etc. Flow of steam injectors and condensers. Three hours. First term. Senior year. Requisite, Mechanical Engineering 28. PROFESSOR STANFORD.

MECHANICAL ENGINEERING 44. *Seminar*.—A continuation of Mechanical Engineering 24. One hour. Both terms. Senior year. Requisite, in last year only. PROFESSOR FERNALD.

MECHANICAL ENGINEERING 45. *Advanced Mechanical Laboratory*.—Testing steam, gas and air engines, and boilers, determining duty of pumps, injectors, air compressors, measurement of flow of steam, calorimetric work. Seven hours first term; two hours second term. Senior year. Requisites, Mechanical Engineering 22, 23, 26, 27, and concurrent with Mechanical Engineering 43. PROFESSOR EHLERS.

MECHANICAL ENGINEERING 46. *Power Plants*.—A discussion of the choice of types of prime movers for various installations, their relative cost, efficiency and durability. Many problems involved in the economic use of various kinds of fuel are presented. Four hours first term for Electrical and Chemical Engineers; four hours second term for Mechanical Engineers. Senior year. Requisite, in last year only. PROFESSOR FERNALD.

MECHANICAL ENGINEERING 47. *Mechanical Thesis*.—Special work in Mechanical Laboratory. Nine hours. Second term. Senior year. Requisite, in last year only. PROFESSOR EHLERS.

MECHANICAL ENGINEERING 48. *Out of Town Inspection Trip*.—An examination of the special features of important engineering developments in various sections of the country. Two weeks. Second term. Senior year. (Probable dates of 1915 trip, March 18 to 31 inclusive.) Requisite, in last year only. PROFESSOR FERNALD.

MECHANICAL ENGINEERING 51. *Steam Engines*.—Thermodynamics of the steam engine, valve and link motions, indicator diagrams, compound engines, governors, fly wheels and auxiliaries. A study of steam engine performance, design and costs. Three hours. First term. Senior year. Requisites, Mechanical Engineering 22, 28. PROFESSOR STANFORD.

MECHANICAL ENGINEERING 52. *Steam Turbines*.—Theory of the steam turbine; advantages claimed for the different types; reported efficiencies and economies. Three hours. Second term. Senior year. Requisites, Mechanical Engineering 22, 28. PROFESSOR STANFORD.

MECHANICAL ENGINEERING 53. *Steam Machinery Design*.—Determining the proper proportions of the parts of steam engines, boilers and turbines, calculating where a question of strength enters, and following commercial types for proportions that are determined solely from experience. Six hours. Second term. Senior year.

Requisite, Mechanical Engineering 51 and concurrent with Mechanical Engineering 52. MR. BARK.

MECHANICAL ENGINEERING 54. *Heating and Ventilation*.—A discussion of the quantities of air required for proper ventilation; a study and layout of different systems of heating and ventilating, including heating from central stations. Three hours. First term. Senior year. Requisite, Mechanical Engineering 28. PROFESSOR FERNALD.

MECHANICAL ENGINEERING 61. *Marine Engines*.—History. Details of marine boilers, engines and accessories. Propulsion, safety devices, management of marine machinery. Compound and triple expansion engines. Two hours. Second term. Senior year. Requisite, in last year only. PROFESSOR EHLERS.

MECHANICAL ENGINEERING 62. *Naval Architecture*.—Displacement, stability, strength of structure, power required, water lines, fineness, etc. Two hours. Second term. Senior year. Requisite, in last year only. PROFESSOR EHLERS.

MECHANICAL ENGINEERING 71. *Graphics*.—Same as Mechanical Engineering 27. For students in Electrical and Chemical Engineering. Three hours. Second term. Junior year. Requisites, Mechanical Engineering 11, 15, 22, Physics 16, 17, 20. MR. CROFOOT.

MECHANICAL ENGINEERING 81. *Hydraulic Engineering*.—Principles of hydraulic turbines; hydraulic power plants; hydrology. For students in Electrical Engineering. Two hours. First term. Senior year. Requisite, Mechanical Engineering 23. PROFESSOR STANFORD.

MECHANICAL ENGINEERING 82. *Applied Thermodynamics*.—Same as Mechanical Engineering 43. For students in Chemical Engineering. One hour. First term. Senior year. Requisite, Mechanical Engineering 28. PROFESSOR STANFORD.

MECHANICAL ENGINEERING 83. *Advanced Mechanical Laboratory*.—Same as Mechanical Engineering 45. For students in Electrical Engineering. Three hours. Both terms. Senior year. Requisites, Mechanical Engineering 22, 23, 26, 71, and concurrent with Mechanical Engineering 82. PROFESSOR EHLERS.

MECHANICAL ENGINEERING 84. *Advanced Mechanical Laboratory*.—Same as Mechanical Engineering 45. For students in Chemical Engineering. Three hours. Second term. Senior year. Requisites, Mechanical Engineering 22, 23, 26, 71, 82. PROFESSOR EHLERS.

MECHANICAL ENGINEERING 85. *Heat Power Engineering*.—The fundamental principles of combustion, steam boilers, steam engines, steam turbines, gas engines and refrigeration. For students in Electrical Engineering. Two hours. First term. Senior year. Requisite, Mechanical Engineering 28. PROFESSOR STANFORD.

MECHANICAL ENGINEERING 91. *Mechanical Drawing*.—For stu-

dents in Chemistry. Two hours. First term. Freshman year. PROFESSOR FRY.

MECHANICAL ENGINEERING 92. *Elements of Engineering*.—Same as Mechanical Engineering 14. For students in Chemistry. Two hours. Second term. Freshman year. MR. CROFOOT.

MECHANICAL ENGINEERING 93. *Steam Engines, Boilers and Power Plants*.—For students in Civil Engineering. Four hours. Second term. Senior year. Requisites, Physics 16, 17. PROFESSOR FERNALD.

PHILOSOPHY.

PHILOSOPHY 1. *Logic*.—Four hours. First term. Two units. DR. SMITH.

PHYSICAL EDUCATION.

PHYSICAL EDUCATION 1 to 4. Medical and physical examination, swimming, tactics, graded gymnastics, free-hand and with apparatus, class athletics and gymnastic games, outdoor track and field athletics, remeasurement and examination. Lectures (second term only) for advanced students on history and physiology of physical training; Anthropometry, gymnastic systems for school, playground, and college; application of exercise for defectives. Prerequisites: for Physical Education 2, Physical Education 1 or its equivalent as provided for in the Gymnasium Manual; for Physical Education 3, Physical Education 2 or its equivalent as provided for in the Gymnasium Manual; for Physical Education 4, Physical Education 3 or its equivalent as provided for in the Gymnasium Manual. Two hours. Both terms. One unit.

PHYSICS.

PHYSICS 16. *Dynamics*.—This course assumes a knowledge of the usual elementary course in Physics as given in an average high school and of Plane Trigonometry. It constitutes, when combined with Physics 17 and 18, a complete course of lectures and recitations in General Physics designed for Engineering students. Must be accompanied by Physics 21. Prerequisites, Entrance Physics and Mathematics E (admission) or F (admission) or 2. Three hours. First term. One and a half units. PROFESSOR GOODSPEED, ASSISTANT PROFESSOR ECKHARDT, ASSISTANT PROFESSOR COPE, ASSISTANT PROFESSOR KABAKJIAN, MR. FUSSLER, DR. R. W. DUNCAN, DR. R. C. DUNCAN, DR. STUHLMANN, MR. OPPITZ.

PHYSICS 17. *Properties of Matter, Heat, Sound and Light*.—The requirements for this course are similar to those for Physics 16. Must be accompanied by Physics 22. Prerequisite, Physics 16. Three hours. Second term. One and a half units. Instructors as for Physics 16.

PHYSICS 18. *Electricity and Magnetism*.—This completes the course in General Physics given to Engineering students. Must be accompanied by Physics 23. Prerequisites, Physics 16 and 17; Mathematics 35. Three hours. First term. One and a half units. ASSISTANT PROFESSOR HARKINS, ASSISTANT PROFESSOR BARKER, ASSISTANT PROFESSOR KABAKJIAN, DR. BOEHM, DR. BOOK, DR. R. C. DUNCAN, DR. STUHLMANN.

PHYSICS 19. *Physical Measurements*.—This course presupposes some knowledge of general physics as well as of Plane Trigonometry. It is a laboratory course consisting of selected experiments in Physics. Prerequisites, Physics 16, 17, 18. Method of instruction: one hour lecture; three hours laboratory work. Four hours. Second term. One unit. ASSISTANT PROFESSOR BARKER, ASSISTANT PROFESSOR HARKINS, ASSISTANT PROFESSOR KABAKJIAN, DR. BOEHM, DR. BOOK, MR. FUSSLER, DR. R. W. DUNCAN, DR. R. C. DUNCAN, DR. STUHLMANN, MR. OPPITZ. (Omitted after 1915-16.)

PHYSICS 20. *Analytic Mechanics*.—A practical course in the elements of Dynamics, consisting largely of problems. It must be preceded or accompanied by a course in Calculus. Prerequisite, Physics 16. Three hours. Second term. One and a half units. PROFESSOR RICHARDS, ASSISTANT PROFESSOR BARKER, ASSISTANT PROFESSOR COPE, ASSISTANT PROFESSOR ECKHARDT, ASSISTANT PROFESSOR HARKINS, DR. BOEHM, MR. FUSSLER, DR. R. C. DUNCAN.

PHYSICS 21 to 24. These are laboratory courses designed to accompany courses 16, 17, 18 and 20. Each consists of a laboratory period of two hours per week and must be accompanied by the corresponding lecture course. Each two hours. One term. One-half unit. Instructors as for Physics 16 to 20.

PHYSICS 26. *General Physics*.—A course in General Physics which in combination with courses 27 and 28 forms the course in Physics intended primarily for the students in the four-year course in Chemistry. Must be accompanied by Physics 27. Prerequisites, Entrance Physics and Mathematics E (admission) or F (admission) or Mathematics 2. Three hours. Both terms. Three units. ASSISTANT PROFESSOR BARKER. (Omitted in 1915-16.)

PHYSICS 27. *Physical Measurements*.—An experimental course in General Physics covering all the subjects of Physics. Must be preceded or accompanied by Physics 26. Four hours. Both terms. Two and a half units. ASSISTANT PROFESSOR BARKER.

PHYSICS 28. *Physics*.—An advanced course in theoretical physics during which a number of special topics are selected for somewhat detailed study. Prerequisites, Physics 26, 27; Mathematics 32. Two hours. Both terms. Two units. PROFESSOR GOODSPEED.

SPECIAL LECTURE.

SPECIAL LECTURE 1. Monthly lectures by visiting engineers. One hour per month. For Senior and Junior Civil, Electrical, Chemical, and Mechanical Engineers.

UNIVERSITY LIBRARY.

EDGAR F. SMITH, PH.D., Sc.D., L.H.D., LL.D., PROVOST.
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KATHARINE S. LEIPER, *Assistant Librarian.*

The LIBRARY is one of the original Departments of the University, possessing among its treasures works presented to the Academy of Philadelphia in 1749; others purchased by a committee of which Benjamin Franklin was chairman in 1750; and still others given by the Rev. William Smith, D.D., first Provost of the College and Academy of Philadelphia; by Louis XVI; and by other early friends and patrons. It now contains 421,097 catalogued volumes and upwards of 50,000 unbound pamphlets.

In exchange for copies of various University publications, the Library is in annual receipt of a large number of periodicals, and of periodical publications and monographs of learned societies in various parts of the world, as well as the journals, dissertations and scientific contributions of the leading educational institutions in this country and abroad. In addition, the Library receives as a depository the documents and publications of the United States Government, and from foreign governments likewise official publications in considerable numbers. The reports of all the important railroad corporations and banking associations are forwarded to the Library; and arrangements have been made to receive regularly state documents and official reports of the more important municipalities in the United States and Europe. The Library has also been made a depository for the printed catalogue cards of the Congressional Library.

The Library is open daily, except Sundays and holidays, from 8.30 A. M. to 10 P. M. (during the summer vacation, 9 A. M. to 5 P. M., and during the sessions of the Summer School, from 8.30 A. M. to 5 P. M.), and the Seminary rooms in the Library building, till 11 P. M.; and both professors and students (the latter upon presenting their matriculation cards) are permitted to take out books. Graduates of all departments of the University, and other persons recommended by an officer of the University, are granted the same privilege, on the annual payment of three dollars. The Library is open freely to the public for consultation, including the unrestricted use of its collections within the building.

DEPARTMENT OF PHYSICAL EDUCATION.

OFFICERS.

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JOSIAH H. PENNIMAN, PH.D., LL.D., VICE-PROVOST.

R. TAIT MCKENZIE, B.A., M.D., *Professor of Physical Education, and Director of the Department.*

W. CAMPBELL POSEY, M.D., *Ophthalmologist.*

GEORGE WILSON, M.D., *Medical Examiner and Physician.*

GEORGE L. DEWALD, M.D., *Medical Examiner and Physician.*

J. C. BIRDSALL, M.D., *Physician.*

W. J. CROMIE, *Instructor in Physical Education.*

LEONARDO TERRONE, *Instructor in Fencing.*

GEORGE KISTLER, *Instructor in Swimming.*

GEORGE DECKER, *Instructor in Boxing.*

GEORGE W. ORTON, PH.D., *Instructor in Track and Field Athletics.*

VIVIAN NICKALLS, *Instructor in Rowing.*

WILLIAM R. GRIFFITH, *Assistant Instructor in Gymnastics.*

CHARLES KERRIGAN, *Assistant Instructor in Swimming.*

ASSISTANTS TO THE OPHTHALMOLOGIST.

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O. LUTHER LATCHFORD, M.D.,

WALTER W. WATSON, M.D.

At a meeting of the Board of Trustees, held in May, 1904, it was resolved that the course in Physical Education be made an integral part of the University curriculum. The following regulations are now in force:

The Gymnasium fee is collected from all students of the Towne Scientific School.

The Bursar's receipt entitles the holder to the use of the Gymnasium, shower-baths, swimming-pool and Franklin Field, except when any or all of them are specially reserved, as, for example, in the

case of intercollegiate games. Due notice of such reservation will be posted on the bulletin boards at the Gymnasium.

Every locker holder is entitled to a physical examination, including his measurements, a strength test, an examination of his heart, lungs, and general condition, with a special examination of his eyes. On the basis of this examination the kind and amount of exercise best adapted to his needs are outlined, and class instruction is given as arranged in the roster at the beginning of the college year.

In the following cases a certain minimum amount of gymnastic or athletic work is required, for which the student receives credit on the basis of laboratory work counting one unit a year toward his degree. In all other cases the work is optional.

Two periods a week are required in the Towne Scientific School, lasting one hour each, of all students, the work to be graded and made progressive throughout the four years.

Exceptional cases may be excused from this requirement when approved jointly by the Director of the Department of Physical Education and the Dean of the Department; and also the following cases:

First, all full students who have, in the opinion of the Director of the Department of Physical Education, had an equivalent amount of work at this, or another, university or college.

Second, holders of a *college degree*.

Third, those having some physical disability.

Membership, and regular attendance at the practice of any of the athletic squads of the University is taken as an equivalent for gymnasium work only during active training, *the attendance being reported weekly*.

Excuse from the requirement, however, does not in any case waive liability for the payment of the gymnasium fee.

FACILITIES AND EQUIPMENT.

I. The UNIVERSITY GYMNASIUM, presented to the Trustees by a committee of the Alumni.

The main exercise hall, 144 by 68 feet, is well lighted by a roof of glass, and has a specially designed system of ventilation, thus ensuring a constant supply of fresh air. The iron work overhead gives attachment to the heavy apparatus. The equipment is so arranged as to be quickly put in place or hoisted out of the way, leaving a clear floor space for large classes; while the floor can be divided into three equal spaces by nets, so as to permit the playing of games in which balls are used without interfering with other work. A small spectators' gallery occupies each end.

On the same floor are two rooms, one at each end, with 2,450 expanded metal lockers, and two small dressing-rooms, with shower-baths, for the members of the Faculty and graduates. On the floor beneath are the towel-rooms and shower-baths. The floor below the exercise hall is occupied by the swimming-pool, the rowing-room, and two boxing, fencing and wrestling-rooms.

The pool, 100 by 30 feet, is supplied by a continuous stream of filtered water, which is completely changed once a week. It is commanded on three sides by a spectators' gallery. All the apparatus for teaching swimming is supplied, and the Instructor or his assistant is always in attendance.

The rowing-room, 75 by 30 feet, is used as an accessory gymnasium, with sixteen machines on which the crew do their winter training; and in it are found additional gymnastic apparatus. The two rooms, 30 by 30 feet each, at either end of the rowing-room, are fitted with all the appliances for teaching boxing, fencing and wrestling.

The Director's office and examining rooms are situated in the north wing, while the corresponding rooms of the south wing contain the offices of the instructors and the superintendent of lockers and attendance.

The basement of each wing is taken up by the special Varsity dressing-rooms with 118 lockers, baths, drying-rooms, repair shop and Instructors' rooms.

II. FRANKLIN FIELD, situated to the east of the gymnasium building and overlooked by it. It is encircled by $\frac{1}{4}$ -mile cinder path and has permanent stands of brick on its north, east and south sides, capable of seating 20,000 spectators. Beneath them are the squash courts and an indoor running track. The stands are connected to the north and south wings of the gymnasium building by brick arches, spanning the entrances to the field.

INSTRUCTION.

Instruction is given in both the theory and practice of Physical Education.

Four courses, A, B, C and D, in theoretical instruction are given.

FIRST TERM.

Course A.—Two demonstrations and lectures a week to candidates for the diploma in Public Health. This course includes lectures on the history, theory and application of anthropometry, the laws of growth in children, with demonstrations in the taking of measurements and the making of physical examinations; the hygiene of

school and college life; exercise for physical and mental defectives, and the application of exercise in Medicine.

Course B.—Two lectures a week to second-year medical students on Physical Therapy, including the application of exercise and massage.

SECOND TERM.

Course C.—Fifteen lectures, leading to a certificate, are given to students who have qualified by two years' experience as class leader in gymnastics and the successful passing of a practical examination in floor work. This course covers the classification and physiology of exercise; gymnastic systems; the application of physical education to school and college; the physical education of defectives, and a review of the conditions in medical practice to which exercise can be applied.

Course B.—Two lectures a week to the second year students in Medicine, on the application of exercise, to defects of posture and development; nutrition; the circulation; and the nervous system.

The practical work of the department applies to the general student body. A careful medical examination, including a thorough test of the sight, is made of all men coming under the regulations on entering college. A series of measurements is taken, particular stress being laid on those which can be changed by judicious exercise; while tests are made also of the strength of the legs, back and shoulders, chest, arms and forearms. On the basis of the information obtained at this examination the students are divided into three classes according to their physical condition. (*a*) Those who are below the normal are given special work to remedy or correct such defects as scoliosis, flat-foot, weak chest, round shoulders, etc., which are susceptible to improvement by prescribed gymnastic exercise. (*b*) For the average man a regular gymnastic course is given, beginning with light free-hand movements, and going forward by easy and progressive steps to the most advanced work on the whole range of gymnastic apparatus. (*c*) For men who are representing the University on the river or the athletic field, or who are trying for any of the teams or crews, credit is given on the basis of gymnastic work as specified in the Manual.

All candidates for teams or crews must pass a satisfactory medical examination by the Director before being considered eligible to represent the University.

Proficiency in swimming is required of all the candidates for crews, and is taught to all students of the first year.

FINANCIAL OBLIGATIONS AND DORMITORIES.

REGULATIONS GOVERNING PAYMENTS.

The following regulations governing the payment of fees, rents, charges, and deposits have been adopted by the Trustees of the University of Pennsylvania, subject to change at their discretion.

I. **MATRICULATION FEE:** In the department where a matriculation fee is charged, that fee shall be paid by all new students, whether previously registered in another department or not.

II. **TUITION FEE:** All fees for tuition and laboratory are charged for the year and payable in two equal instalments. The first payment shall be made upon date of registration, and the second payment, which becomes due February first, shall be made within one week of that date. A student entering after February first shall pay all charges upon registering.

III. **GYMNASIUM AND HOUSTON CLUB FEE:** This fee shall be paid by all male students, excepting those in the Graduate School, Evening School of Finance and Accounts, College Courses for Teachers, Summer School, and special students taking post-graduate work in the Schools of Medicine, Dentistry and Veterinary Medicine. Students in these courses may, however, obtain these privileges upon payment of the fee. Instruction in gymnastics, free use of the gymnasium apparatus and pool, and full membership privileges in the Houston Club are covered by this fee, which is payable in two equal instalments when tuition fees are due.

IV. **DORMITORY RENTS AND CHARGES:** Rents are due and payable one-half October 1 and one-half February 1. If the lease is signed after October 1, the first half is due when the lease is signed, and the second half is due February 1. If signed after February 1, the entire rent is due when the lease is signed. Charges are due as they are incurred.

V. **GRADUATION FEES:** Graduation and certificate fees are due May 15.

VI. **DEPOSITS:** Every student shall, upon entering the University, make a deposit of an amount required in the course in which he registers, to cover loss, damage, or breakage of University property, library fines, or any charge not paid by the student in some other way. A student whose deposit is by charges against it reduced to one-half its original amount or less shall be required to pay a sum sufficient to restore the deposit to the original amount. A student entering another class or department shall make up his deposit to the

amount required in that class or department, if the amount be larger, or may reduce his deposit if the amount be smaller. A student registered in two departments is required to pay a deposit in each. No deposit or balance remaining on a deposit shall be finally repaid to a student until he shall have been graduated, or shall have formally withdrawn from the University.

FAILURE TO PAY.

If a student fails to pay his fees and other charges in accordance with the above regulations, his name is dropped from the University rolls and he is excluded from lectures, recitations, practical work and examinations until payment is made. The student will be held accountable for all absences incurred through the operation of this rule. If payment in full is not made within three weeks of the date upon which the charges become due, the student will be dropped from his class.

WITHDRAWALS, ALLOWANCES AND SPECIAL RULES.

WITHDRAWAL: Separate written notice must in all cases be given to the Dean and the Bursar at the time of withdrawal if a student wishes to secure any of the allowances granted in special cases, as follows:

(1) A student who withdraws within one week of the date on which he registered may receive a return of the full amount of the tuition paid, but in no case will the matriculation fee be returned.

(2) A student who leaves the University for any cause, after the first week and within thirty days from the beginning of either the first or second term, will be entitled to a return of one-half of the term's fees.

(3) A student who, on account of illness or other physical disability, withdraws during the term will be entitled to a return of an amount which shall be such proportionate part of the entire tuition fee as the number of weeks in which he is not in attendance bears to the number of weeks in the academic session, provided such proportionate part be not more than one-half of the term's fees.

(4) A student who withdraws after November 1, or March 1, of any year, for causes other than illness or physical disability, will be given no reduction in the term's fee.

Withdrawal from the University does not cancel a Dormitory lease. Whenever possible, a room given up will be re-rented, and a charge made only for that period in which the room is held in the

lessee's name. Should no subsequent tenant be found, the lessee will be held responsible for the full year's rental.

LEAVE OF ABSENCE: The Dean of any faculty may, for good cause, grant a leave of absence to a student in good standing who applies in writing. No fees will be returned in such cases, but an allowance will be made upon the fees when the student re-enters the course, proportionate to the unexpired period of the session in which leave of absence was granted.

REPEATING A YEAR: A student who does not complete the work for a degree or certificate within the time indicated for the course shall in any succeeding year or years pay tuition for all subjects then or previously repeated in class, provided that in no year shall the fee so paid exceed the regular fee for the course.

CREDIT FOR ADVANCE STANDING: A student who enters any department, or who is transferred from one department to another, with advance standing, will be given financial credit for all subjects in which advance standing is given, provided that, if the student takes more than the minimum amount of work required for a degree or certificate, or repeats any subjects in class, the fee for the subjects so taken in excess or repeated shall be deducted before the allowance is made.

A student, pursuing work in the Summer School of the University for which advance credit toward a degree or certificate is given in any other department of the University, will be given financial credit for all subjects in which advance credit is given.

SPECIAL STUDENTS: Special students in any department will pay the full tuition fee of regular students in that department.

CHANGING COURSES: A student who is transferred during the year from one department to another shall pay in each department a fee proportionate to the length of attendance.

LATE REGISTRATION AND ABSENCE: Late registration shall not entitle the student to a reduction in fees.

RIGHT TO WITHDRAW OR GRADUATE: No student shall be granted a certificate of withdrawal or be graduated who has not paid in full all his financial obligations to the University.

PAYMENTS—CASHING STUDENTS' DRAFTS.

Payments due the University must be made in cash, or by certified cheque, bank draft, or postal money order, drawn for the exact amount due.

As an accommodation to students, the Bursar will cash at his office, 102 College Hall, bank drafts on Philadelphia or New York, and postal money orders, for not more than \$150.00.

DORMITORIES.

The dormitory buildings are in one continuous group surrounding two open courts; the most recent buildings are on two sides of what will in time be a third enclosed court. Lists of vacant rooms, prices and other information will be furnished by the Bursar of the University, Room 102, College Hall.

Rooms are of five classes, viz.: *triple suites*, consisting of bedrooms and study for three students; *double suites*, consisting each of two bedrooms and one study, for two students; *single suites*, consisting each of one study and one bedroom for one student; *double rooms*, which are large single apartments furnished for two students; and *single rooms*, of various sizes, each furnished for one student.

All rooms and halls are heated by steam and lighted by electricity. The buildings are on the "separate staircase" system, all doors opening into the courts. On every staircase, and (in nearly all the houses) on each floor, are lavatories, with hot and cold shower-baths, etc. Almost all the suites and double-rooms, and many of the single rooms, have open fireplaces. The University supplies for each student the following furniture: a single bedstead, mattress, bureau, washstand, table, bookcase, chairs and toilet china.

Dormitory rooms may be engaged by present students in any department of the University, or by those intending to be students during the coming year, upon either of the following conditions:

(a) By paying in advance the full year's rental for the room desired, plus a deposit of ten dollars (\$10.00) to cover possible damage, any balance remaining to be returned when the room is finally given up.

(b) By filing with the application for a room a bond securing the full amount of the rent and charges; the printed form for the bond may be had upon application to the Bursar. When two students wish to occupy a room together, each must file a bond. The bond must be signed by two responsible property owners, of whom one must be a citizen of the United States. No student or officer of the University will be accepted as bondsman. The bond may not be signed by a married woman whose husband is living, and it is preferred that both sureties should be men.

Every student not previously a resident in the dormitories who files a bond with his application shall be required upon the signing of his lease to pay ten dollars (\$10.00). Twenty dollars (\$20.00) shall be paid by a student who alone leases a double room or double suite. This payment shall apply as a part payment on the first term's rent. In case the lessee desires to give up his room on or before the opening day of the University, he may do so by notifying the Bursar in writing, and the bondsmen shall thereupon be released from

further liability for the rental of the room, but the payment made at the signing of the lease shall be forfeited. A similar forfeit shall be deducted when a student who had engaged his room by making the full payment of rental and deposit in advance, as specified above, desires to give up his room. The balance due shall thereupon be returned to him.

Rents are payable in advance in two equal instalments, due October 1 and February 1, respectively. (For rules regulating payments see "Regulations Governing Payments.")

Although no preference in the assignment of rooms is given on account of length of residence at the University or in the dormitories, or on account of membership in any particular department of the University—except as hereinafter stated concerning the house set aside for students in the Graduate School—present occupants of the rooms, who intend to be matriculated as students in some department of the University during the academic year 1915-16, may engage their present rooms for that year by signing new room agreements. These must be filed with the Bursar not later than March 29, 1915. A room may not be leased in the spring by the present occupant, held until the fall, and transferred at that time to another student. If the room is to be re-assigned, it must be offered first to those on the "waiting list" for dormitory rooms at that time.

Other rooms for 1915-16 will be assigned by lot. A list of the rooms to be assigned will be ready for distribution on April 5, 1915. Applications from present students of the University in any department, or from those intending to be students during the year 1915-16, will be received until noon on April 26, 1915. Assignments will be made by lot. When the name of an applicant is drawn the *first* number on his list will, if possible, be assigned to him. But if that is already taken, the *second* number on his list will be assigned, if possible, and so on.

Assignments will be announced on April 27. Leases must be signed and the initial payment mentioned above must be made on May 8, 1915.

Any rooms remaining unassigned on April 27 will be assigned in the order in which applications are received. When all the rooms have been assigned the Bursar will receive applications for places on the "waiting list." Rooms thrown open for re-assignment will be offered first to those on this list. All tenants must complete registration and show matriculation cards for the year 1915-16 at the dormitory office by October 8, 1915. The Graduate House, which has been set aside for the exclusive use of students in the Graduate School, adjoins the tower on the eastern side of the "Big Quad." In addition to the rooms and suites of tenants, there is on the first floor

a large reception room for general use. The method and terms of assignment of rooms in this house are the same as for other dormitory rooms, excepting that applications must be approved by the Dean of the Graduate School before assignments are made.

Attention is called to the following regulation of the Board of Deans with regard to the occupation of dormitory rooms by special and partial students:

"Except by special permission of the Provost, no special or partial student may be assigned to a room in the dormitories unless he is taking in the University 50 per cent. of the number of hours a week required of regular students in the department in which he is registered. When, however, the number of hours a week required of regular students in the department varies as between two or more classes, the hours required of a special or partial student to entitle him to be assigned to a room will be calculated upon the basis of hours required of regular students in that class in his department which is required to take the greatest number of hours a week. Regular students in the Graduate School who are not 'in residence,' in the sense of that term as defined in the rules of the department, are considered as falling within the class of 'special and partial students' as regards dormitory rooms."

"A student who holds a dormitory room loses his right to such room (1) when he ceases to be a student in any department of the University; (2) when he seriously infringes the rules regulating his conduct in the dormitories; (3) when being a regular student, he becomes a special or partial student taking less than the number of hours required of such students as stated above; or, when, being a special or partial student, he ceases to take the number of hours required of such students as above stated; and, (4) when he or his room-mate ceases to occupy the room regularly."

In the assignment of a suite or double room, preference will be given to an application signed by two students who will use the room together. Two students wishing to apply for a room together should both sign an application for the room; such an application will be given two chances in the allotment, and any room drawn will be assigned to both the applicants. The University, however, reserves the right to cancel any assignment of a room if it is not duly claimed and occupied throughout the year by the student or students signing the application. Suspension or expulsion from the University, or serious infringement of the rules, will be considered sufficient grounds for the cancellation by the University of any lease. Subletting or exchange of rooms is not permitted. Voluntary withdrawal from the University does not of itself cancel a lease. The student who wishes to withdraw after the opening day of the Uni-

versity should apply to the Bursar for the terms upon which his lease may be cancelled. The tenant is held for the full year's rent and charges; but when the room is vacated before the end of the college year, the bondsman shall not be held responsible for the rent of the room for the rest of the year if the room is rented to another tenant.

If one of two room-mates is expelled or suspended, or so infringes University rules as to make his removal from the dormitories necessary, the other room-mate may have the room assigned to him by immediately signing a new application; provided that there are not two other students applying together for the room. Or he may hold the room by taking another room-mate, who must be qualified by filing an application and bond. If he fails to hold the room in one of these two ways the University may, after giving him notice, require him to vacate the room.

Rentals are for the full college year: that is, from the Saturday before the opening of the University to the Saturday after Commencement Day, inclusive. Occupancy of rooms during any time not included within the regular lease must be paid for as an extra charge. Rents include heat and all reasonable care of rooms, and also light, except in the Memorial Tower, Bodine, Robert Morris, and all houses east of Memorial Tower, in which the rooms are supplied with meters, tenants being charged according to the amount of light used. Additional service in the care of rooms must be paid for as extra, and must, in all cases, be performed by persons authorized by the University. Cooking of food in the rooms is strictly prohibited.

The Parietal Committee, appointed by the Trustees to have charge of the discipline of the dormitories, consists of the five Proctors, resident in the dormitories, and one other person, appointed by the Provost. The students in each house of the dormitories elect one of their number as a Representative, and these Representatives form a Board which meets regularly and acts with the Parietal Committee.

UNIVERSITY COMMITTEE ON STUDENTS' RESIDENCES.

The University reserves the right to refuse permission to students to reside in any house not approved by the University Committee on Students' Residences.

UNIVERSITY OF ILLINOIS-URBANA



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